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ORIGINAL RESEARCH

Comparative study of bond strength of tubes bonded to a resin surface on the buccal aspect of molars using Empress Direct resin and Transbond XT resin: an *ex vivo* study

Estudio comparativo de la resistencia al desprendimiento de tubos adheridos a una superficie de resina obturada sobre la superficie bucal de los molares con la resina Empress Direct y con la resina Transbond XT: un estudio ex vivo

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ABSTRACT

Objective: To assess the detachment of tubes bonded to the first molars on a resin surface without surrounding dental enamel, which were bonded with the same restorative resin Empress Direct and the Transbond XT resin, testing three preparation methods of the resin surface. **Material and methods:** The sample consisted of 120 third molars, which were prepared with cavities in the buccal aspect and restored with Empress Direct, which in turn, were divided into six groups. In the case of groups I and II 37% phosphoric acid was placed on the surfaces of the resin restorations; the tubes were bonded on the surface using for group I Empress Direct resin and for group II, Transbond XT. On groups III and IV phosphoric acid and silane were placed; the tubes were bonded with the two types of resin in the same way as in groups I and II. In groups V and VI the resin surface was sandblasted with 50 µ aluminum oxide and conditioned with 37% phosphoric acid and silane. Finally, we evaluated the tubes bond strength. **Results:** Group I, in which 37% phosphoric acid was used, the bond strength was 2.71 ± 1.06 (MPa) and for Group II, it was 3.32 ± 1.06 (MPa). Group III, in which phosphoric acid and silane was used had a bond strength of 4.45 ± 1.46 (MPa) and group IV showed a bond strength of 6.64 ± 1.93 (MPa); for group V which used sandblasting, orthophosphoric acid and silane, bond strength was 9.55 ± 3.0 (MPa) and for group VI it was 10.56 ± 3.88 (MPa). **Conclusions:** The bond strength of tubes increases when the resin surface is prepared with sandblasting, 37% phosphoric acid and silane with both Empress Direct and Transbond XT resins.

RESUMEN

Objetivo: Evaluar el desprendimiento de tubos adheridos a los primeros molares sobre una superficie de resina sin esmalte dental circundante, los cuales fueron pegados con la misma resina restauradora Empress Direct y la resina Transbond XT, probando tres métodos de preparación de la superficie de resina. **Material y métodos:** La muestra constó de 120 terceros molares, los cuales se prepararon con cavidades por la cara vestibular y se obturaron con la resina Empress Direct, los cuales a su vez se dividieron en seis grupos. En el caso de los grupos I y II se colocó ácido ortofosfórico al 37% en las superficies de la obturación de resina; se pegaron los tubos sobre la superficie utilizando para el grupo I la resina Empress Direct y para el grupo II la resina Transbond XT. A los grupos III y IV se les colocó ácido ortofosfórico y silano; se pegaron los tubos con los dos tipos de resina de la misma forma que en los grupos I y II. En los grupos V y VI se arenó la superficie de resina con óxido de aluminio de 50 µ, más la colocación de ácido ortofosfórico al 37% y silano. Finalmente, se evaluó la resistencia al desprendimiento de los tubos. **Resultados:** En el grupo I en el que se utilizó ácido ortofosfórico al 37% la resistencia correspondió a 2.71 ± 1.06 (MPa) y del grupo II fue de 3.32 ± 1.06 (MPa). Para el grupo III en el cual se utilizó ácido ortofosfórico y silano fue de 4.45 ± 1.46 (MPa) y para el grupo IV fue de 6.64 ± 1.93 (MPa); para el grupo V en el que se utilizó el arenado, ácido ortofosfórico y silano, fue de 9.55 ± 3.0 (MPa) y del grupo VI fue de 10.56 ± 3.88 (MPa). **Conclusiones:** La resistencia al desprendimiento de los tubos se incrementó cuando se preparó la superficie de la resina con el arenado, ácido ortofosfórico al 37% y silano tanto con la resina Empress Direct como con la resina Transbond XT.

Key words: Tubes bonded to resin surfaces in molars, sandblasting, bond strength.
Palabras clave: Tubos adheridos a molares sobre resina, arenado de superficie, resistencia al desprendimiento.

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INTRODUCTION

Throughout the history of orthodontics, an intense search for different techniques for improving bracket adhesion to the surface of enamel has been performed. These techniques include studies and tests to develop an ideal adhesive, the modification of the base of the bracket or the preparation of the tooth surface using acids. The purpose has been to obtain an adequate retention, as well as allow for greater resistance to detachment from the brackets and tubes on the surface of the enamel to adequately perform the tooth movement during orthodontic treatment, through the use of the best support of masticatory forces during treatment.

Today it is common to use fixed orthodontic appliances or auxiliaries bonded on composite resins as is the case of preparations for class III and IV restorations in anterior areas and classes I and II in posterior areas as well as classes V, commonly in adult patients who were treated with aesthetic restorations. However, orthodontic appliances that are used on this type of restorations generally debond frequently due to the lack of a good adhesion on the restoration.[1]

Different methods have been developed to increase retention of these attachments such as the preparation of the surface through mechanical or chemical means, or with the combination of both.[2] Mechanical site preparation may include sanding or scraping the surface with carbide or diamond. Chemical preparation to increase the strength of adhesion is performed by etching the surface with hydrofluoric acid, or with the implementation of a silane, a bonding agent or plastic conditioner.[1]

On the other hand, some studies have shown that abrasion of the enamel surface with aluminum oxide particles of 50 microns and the application of resin significantly improve the resistance to debonding of orthodontic appliances. Sandblasting with the same compound of aluminum oxide must be of 90 microns.[1,3,4] In addition, there are other methods such as the application of hydrofluoric acid and 37% ortophosphoric acid on the surface of a hybrid type resin; however, these techniques have proven to be less effective in the bonding of orthodontic appliances, which gives as a result the detachment of brackets or buccal tubes thus causing an increase in total treatment time.[1]

No matter that the type of resin used to seal the cavity over which orthodontic brackets and tubes are bonded is one of several factors that influence the resistance to adhesion of these restorations, it has been shown through some studies that nanofill type resins have a lower resistance to adhesion of appliances over the restoration surface by fracture or stress. Fluid resins and conventional resin are next. However, the hybrid type resin has been shown to have greater resistance to debonding of orthodontic tubes.[5-11]

The purpose of this study was to assess debonding of tubes bonded to first molars, on a surface of resin without surrounding dental enamel, which were restored with the same restorative resin (Empress Direct) and the resin Transbond XT, testing three methods of preparation of the resin surface.

MATERIAL AND METHODS

The sample for the study consisted of 120 third molars –upper and lower– recently extracted, randomly selected. The sample was divided into six groups of 20 specimens each. The specimens were kept in sterile containers and were preserved in distilled water at room temperature *(Figure 1)*, which was changed once per week to prevent bacterial growth. This procedure was performed from the moment the teeth were extracted until the completion of the experimental procedure for this study.

The inclusion criteria were: that the enamel did not have decalcifications, pigmentations, or fluorosis; without any kind of active caries process; that there was no presence of fractures, fissures, erosions, or restorations on the buccal surfaces and that they were not stored in any chemical environment. All those molars that did not meet the inclusion criteria mentioned above were excluded.

On all specimens a cavity of 0.5-1 mm in depth was prepared, with an area larger than the size of the base

Figure 1. The sample consisted of 120 upper and lower third molars.