

Adhesive bond strength between orthodontic resin and acrylic surfaces

Fuerza de unión adhesiva entre resina de ortodoncia y superficies acrílicas

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DOI: 10.35429/EJRG.2020.10.6.1.5

Received March 12, 2020; Accepted June 30, 2020

Abstract

The use of orthodontic treatments in patients with temporary prostheses has been increasing, the purpose of this *in vitro* research is to measure the adhesive bond strength between orthodontic resin and acrylic surfaces by applying different procedures. Objective. To compare the adhesive bonding strength between orthodontic resin and acrylic surfaces under different application protocols. Methodology. Transversal, experimental, prospective study. *In vitro* with acrylic provisions, was carried out in the laboratory of the Faculty of Dentistry of the Universidad Veracruzana region of Veracruz. In the period of February-June of the year 2019. The sample was conformed by two control groups of specimens and four experimental ones, each group conformed by 20 specimens, in total 120 provisional ones were made in acrylic Nic Tone of quick self-cure. The tests performed by the ULTRATESTER machine were expressed in MPa. Later, the data obtained were processed in Excel tables (version) for statistical processing in SPSS version 24. Contribution. When comparing the pre-cutting protocol of acrylic surfaces with fine diamond bur and the protocol without pre-cutting, no statistically significant differences were found, therefore, this step could be omitted in clinical practice.

Adhesive System, Provisional, Acrylic Resin, Orthodontic Resin

Resumen

El uso de tratamientos de ortodoncia en pacientes con prótesis provisionales ha ido en aumento, el propósito de esta investigación *in vitro* es medir la resistencia de unión adhesiva entre resina de ortodoncia y superficies acrílicas aplicando diferentes procedimientos. Objetivo. Comparar la fuerza de unión adhesiva entre resina de ortodoncia y superficies acrílicas bajo diferentes protocolos de aplicación. Metodología. Estudio transversal, experimental, prospectivo. *in vitro* con provisionales de acrílico, se llevó a cabo en el laboratorio de la Facultad de Odontología de la Universidad Veracruzana región Veracruz. En el periodo de febrero-junio del año 2019. La muestra estuvo conformada por dos grupos control de especímenes y cuatro experimentales, cada grupo conformado por 20 especímenes, en total se realizaron 120 provisionales en acrílico Nic Tone de autocurado rápido. Las pruebas realizadas por la máquina ULTRATESTER fueron expresadas en MPa. Posteriormente los datos obtenidos fueron procesados en tablas de Excel (versión) para su procesamiento estadístico en SPSS versión 24. Contribución. Al establecer la comparación entre el protocolo de tallado previo de superficies acrílicas con fresa de diamante fino y el protocolo sin tallado previo, no se encontraron diferencias estadísticamente significativas, por lo tanto, se podría omitir este paso en la práctica clínica.

Sistema Adhesivo, Provisional, Resina Acrílica, Resina de Ortodoncia

Citation: TORRES-CAPETILLO, Evelyn Guadalupe, CAPETILLO-HERNÁNDEZ, Guadalupe Rosalía, ROESCH-RAMOS, Laura and MORENO-MARIN, Flora. Adhesive bond strength between orthodontic resin and acrylic surfaces. ECORFAN Journal-Republic of Guatemala. 2020, 6-10: 1-5

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Introduction

At present, adhesive systems are of utmost importance for restorations in dentistry, since they can provide different treatment options depending on the indications and needs of each patient. The adhesives allow to reduce the operative times of the treatments to be carried out. Hence the importance of determining which is the material or technique that provides the best adhesive bonding strength on the surfaces to be treated.

Every day it is more common to perform orthodontic treatments in patients who use prostheses or individual provisional restorations, this point requires a greater understanding of the subject related to the use of materials and techniques different from conventional ones, which can guarantee excellent adhesion of the brackets to the surface of the provisional, as well as the good condition of the restorations.

Currently, the progress of adhesion biomaterials is focused on the improvement of their components, the functioning of the material and the simplification of techniques in clinical procedures, in order to achieve better results in less time.

However, the bond strength between orthodontic resin, adhesive, and acrylic surfaces remains a concern during orthodontic treatment, as the literature is still quite sparse when it comes to adhesive bonding to acrylic provisionals.

The purpose of this *in vitro* research is to measure the adhesive bond strength between orthodontic resin and acrylic surfaces applying different treatments.

Adhesion is of great importance for current dentistry since there are studies that show its failure, due to various factors, both internal and external, either through the operator or the adhesive system, also associated at the same time with factors such as be of mechanical, chemical origin or due to environmental issues such as saliva or blood, due to the absence of absolute isolation and, in addition to them, it is manifested that the more steps the placement of them takes in the dental organs to be treated, the more susceptible to commit some error in your application.

Accession

Adherence in the dental field is of great importance, since a large part of the success of dental treatments depends on it. Today, there is a constant updating of materials and the relationship of adhesive systems with different dental tissues and restorative materials. Days, 2015.

It is the state by which two different surfaces or materials are held together by interfacial forces, either by physical bonds, by chemical bonds, or by both.

It is all that substance placed in the middle of two surfaces in contact by mechanical means with one another, which can maintain their union either chemically or physico-chemically. Adherence protocols have become the foundation of dentistry. The transformation of adhesive systems has been obtained through various investigations that bifurcated into effective formulas.

Dental protocols and novel adhesion techniques have increased their effectiveness and reliability for the performance of various dental treatments, obtaining high efficiency in mechanical bonding in conjunction with enamel and dentin. With the emergence of hydrophilic adhesion systems, in synergy with dentin modification, a wide range of possibilities was obtained for the application of numerous treatments since, thanks to their characteristics, they offer multiple applications and advantages in restorative treatments, magnifying benefits. Camacho et al. 2014.

Currently, adhesion systems are the basis for the vast majority of dental procedures, such as those in rehabilitation by direct technique, cementation of inlays, onlays, crowns and fixed prostheses, whether aesthetic or metallic, placement of endoposts, whether fiberglass or metallic.

A double action mechanism process is characterized by the adhesive capacity of the adhesive systems, through adhesion to dental tissues and attachment to the restored area, the latter being a chemical or micromechanical bonding process, since bonding to enamel is a micromechanical bond that represents the main bonding mechanism. Santana de Ávila, E. L et al. 2019.

Overall objective

Compare the adhesive bond strength between orthodontic resin and acrylic surfaces under different application protocols.

Specific objectives

- Fabricate 25 mm by mm epoxy resin specimens, with an acrylic resin provisional included.
- Submit specimens to adhesion protocols a) Conventional method, b) Silanized, c) with plastic packaging)
- Apply shear force on Ultratester (Ultradent)

Methodology

This research was carried out according to the ISO 29022: 2013 standard, which specifies a test method that is aimed at evaluating the strength of the adhesive bond between dental materials and dental structure, however, in this study, this modified method was used to measure adhesion to acrylic structure.

Study is cross-sectional, experimental, prospective

The in vitro study with acrylic provisionals was carried out in the laboratory of the Faculty of Dentistry of the Universidad Veracruzana in the Veracruz region. In the period of February-June of the year 2019.

The sample consisted of two control groups of specimens and four experimental, each group made up of 20 specimens, a total of 120 provisionals were made in quick self-curing Nic Tone acrylic, in shade 66, they were made with the polyvinyl siloxane key technique, sectioned with diamond disc and later placed in containers made of stainless steel 25 mm in diameter by 25 mm in height, to include them in epoxy acrylic resin, made according to ISO 29022: 2013, the specimens were polished with a sandpaper sheet of fine and ultra fine grade, aiming to smooth the acrylic surface. The specimens were cleaned and disinfected with ultrasound and distilled water for 5 minutes, later they were dried with hot air. Once the specimens were obtained, they were prepared in experimental groups, following the manufacturer's instructions for the different adhesion systems used.

A total of 120 specimens were obtained, dividing into two control groups (GC1 and GC2) and 4 experimental (GE1) (GE2) (GE3) (GE4) each consisting of 20 specimens.

In control group 1 (GC1), the conventional adhesive system comprising the application of Ortho Solo adhesive was applied to the uncut acrylic surface, it was light-cured for 20 seconds and then the orthodontic resin was placed and light-cured for 20 seconds with a Valo lamp. .

In control group 2 (GC2), the acrylic surface was carved with a fine diamond bur, the Ortho Solo adhesive system was applied, it was light-cured for 20 seconds and the orthodontic resin was placed light-curing for 20 seconds using the Valo lamp.

In experimental group 1 (GE1), silane was applied and carved with microbrush on the uncut acrylic surface, a period of 10 seconds was given for the silane to fulfill its function, Ortho Solo adhesive was applied, light-cured for 20 seconds and He proceeded to place the orthodontic resin, light-curing for 20 seconds with a Valo lamp.

Experimental group 2 (GE2) It was applied by scrubbing with a Reliance plastic conditioner microbrush, a period of 10 seconds was given for the Reliance plastic conditioner to fulfill its function, Ortho adhesive was applied alone, light-curing for 20 seconds and the orthodontic resin was placed light-curing for 20 seconds with a Valo lamp.

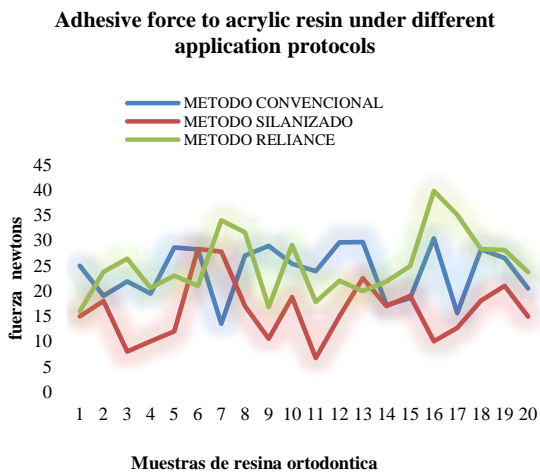
Experimental group 3 (GE3) The acrylic surface was carved with a fine diamond bur and the same procedure was carried out as in experimental group 1 (GE1).

Experimental group 4 (GE4) The acrylic surface was carved with a fine diamond bur and the same procedure was carried out in experimental group 2 (GE2).

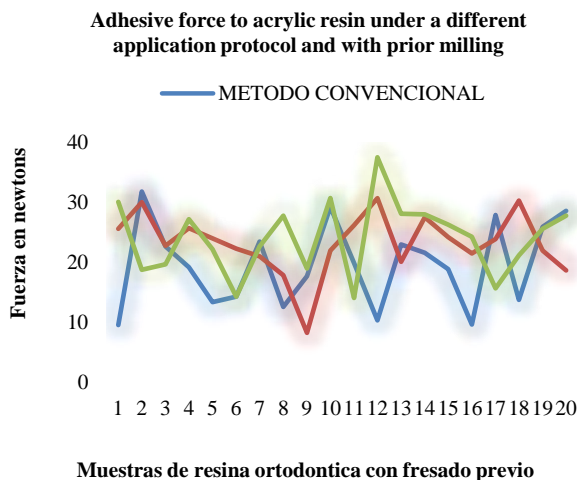
Finally, the 2 control and experimental groups were subjected to shear forces in the Ultradent ULTRATESTER machine in order to measure the adhesive bond strength between orthodontic resin and acrylic surface.

Results

According to the results obtained in the inferential statistical analysis (ANOVA), the application protocol that showed the highest adhesive strength between orthodontic resin and acrylic surfaces was plastic conditioning (Reliance®) with an average of 25.18N without prior milling, followed of the conventional protocol with an average of 23.86 N and for the Silanized protocol an average of 16. 11 N showing the lowest adhesive force.



Graphic 1 Comparativo de la fuerza adhesiva a resina acrilica bajo protocolo de aplicación distinto sin fresado previo, observando mejores valores para el protocolo Reliance, seguido del protocolo convencional



Graphic 2 Comparison of the adhesive force to acrylic resin under a different application protocol with previous milling, observing better values for the Reliance protocol, followed by the Silanized protocol

Adhesive		
HSD Tukey ^a		
PRIOR		Subset for alpha = 0.05
PROTOCOL_WITH_MILLING	N	1
conventional protocol	20	19.6850
Silanized protocol	20	23.2350
Reliance protocol	20	24.0550
S.I.G.		.066
The means for the groups in the homogeneous subsets are displayed.		
a. Use the sample size of the harmonic mean = 20,000.		

Table 1 Ti Diferencia entre grupos, siendo el protocolo convencional el que presenta menor rendimiento a la fuerza de adhesión

Discussion

The use of a self-etching adhesion system, even after internal whitening, presents acceptable FRZ values in the adhesion of brackets in orthodontics. M. Lobato Carreño, et a. 2015.

Conclusions

When a comparison is made between the protocol for prior grinding of acrylic surfaces with a fine diamond bur and the protocol without prior grinding, no statistically significant differences were found; therefore, this step could be omitted in clinical practice.

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