ADHESION OF ORTHODONTIC TUBES TO DENTAL ENAMEL: COMPARISON OF DIFFERENT BONDING PROTOCOLS

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ABSTRACT

Adhesion failures between orthodontic appliances and tooth enamel are common and occur more frequently in posterior teeth. An additional layer of orthodontic adhesive at the interface between the tooth and the occlusal surface of the accessory appears to be a promising maneuver, but the results are controversial. The aim of this study was to compare the shear bond strength (SBS) of orthodontic tubes bonded to tooth enamel following three different protocols. Forty-five bovine incisors were randomly divided into three groups: Group 1 – Transbond XT without reinforcement (control group); Group 2 – Transbond XT + reinforcement with Grandioso Heavy Flow flowable resin; and Group 3 – Transbond XT + reinforcement with conventional Forma resin. The specimens were subjected to a shear test using a universal testing machine with a knife blade tip and a speed of 0.5 mm/min. The shear strength was higher in Group 2 when compared to Group 1. There was no statistically significant difference when comparing Groups 1 and 3, or 2 and 3. The RUC was higher in Group 2 when compared to Group 1. Reinforcement with flowable resin increases the RUC when compared to conventional bonding.

Keywords: Fixed appliances; Dental bonding; Orthodontic adhesives; Composite resins;

INTRODUCTION

Orthodontic accessories, such as tubes, brackets, and buttons, are devices bonded to the tooth surface that transmit orthodontic forces to the tooth, enabling tooth movement. In this sense, in order to avoid delays in orthodontic treatment due to adhesion failures between the accessories and the tooth surface, several bonding protocols with different types of materials and tooth surface conditioning have been proposed (HADROUS et al., 2019; MILLETT et al., 2011; OZTURK et al., 2008).

Adhesion failures are common during orthodontic treatment (ALMOSA et al., 2018; DUDÁS et al., 2022), with posterior teeth being more affected than anterior teeth (KHAN et al., 2022). In particular, the rate of these failures in molar s is approximately

11% considering the first twelve months of treatment (JUNG, 2014; PANDIS; POLYCHRONOPOULOU; ELIADES, 2006).

Despite the ease of bonding orthodontic accessories, failure of tube adhesion or spontaneous removal by the professional can cause damage to the enamel, such as increased roughness (JANISZEWSKAOLSZOWSKA et al., 2014; MOHEBI; SHAFIEE; AMELI, 2017; PONT et al., 2010). In this sense, bonding methods that reinforce the adhesion strength of the accessory to the tooth have been proposed, thus avoiding re-bonding.

The available studies on the addition of a resin layer at the orthodontic tube/tooth interface have only tested orthodontic adhesives or flow-type resins (VEIGA-JARDIM et al., 2020; PINZAN-VERCELINO et al., 2011), despite the diversity of composite resins available on the market. Thus, the aim of this study was to evaluate the bond strength between orthodontic adhesive and tooth enamel in teeth that underwent and did not undergo bonding reinforcement procedures, using *flow-type* resin and conventional resins.

METHODOLOGY

Forty-five permanent bovine teeth were embedded in self-curing acrylic resin (Auto Jet, São Paulo, Brazil) with the vestibular surface exposed, then numbered and randomly distributed by drawing lots into three groups according to the bonding protocol (n = 15 in each group), as follows: Group 1 – Transbond XT without reinforcement (control group); Group 2 – Transbond XT + reinforcement with Grandioso Heavy Flow resin; Group 3 – Transbond XT + reinforcement with Forma resin.

The method for bonding the orthodontic tubes was based on the work of Veiga-Jardim et al. (2020).

For Group 2, reinforcement was performed with a high-load flow-type nanohybrid resin. The resin was applied using an applicator tip on the occlusal surface of the tube and polymerized for 20 seconds. For Group 3, reinforcement was performed with Forma nanohybrid resin (Ultradent), color A2, also applied using a nd polymerized

for 20 seconds. After bonding the tubes, the specimens were kept in distilled water for 24 hours.

For the mechanical test and measurement of Shear Bond Strength (SBS), a Microtensile universal testing machine model OM150 (Odeme, Luzerna, Santa Catarina, Brazil) was used. A knife blade tip was used at a speed of 0.5 mm/min and a force of 100 kgf. The tip was positioned so as to exert force on the occlusal region of the orthodontic tube. A light microscope was used to determine the type of failure that occurred: failure between the enamel and the adhesive system; or between the adhesive system and the tube.

RESULTS

The RUC was higher in Group 2 when compared to Group 1. Group 3 showed lower RUC than Group 1 (Table 1). Most cases showed mixed fractures between the resin and bracket.

Table 1. Shear test data

Grupo	Força (kgF)	Força (Newton)	Área (mm²)	RUC (Mpa)
Transbond	9,16 (5,07)^{A}	89,83 (49,75)^{A}	17,48 (1,75)^{B}	5,14 (2,88)^{A,B}
Transbond + Flow	10,30 (2,96)^{A}	101,05 (29,08)^{A}	18,00 (2,89)^{C}	5,72 (1,84)^{A}
Transbond + Convencional	8,29 (3,77)	81,32 (36,95)	20,52 (3,83)^{B,C}	4,04 (1,85)^{B}

Letras semelhantes indicam diferenças estatisticamente significantes entre os grupos na mesma coluna, teste T de Student.

Source: Authors, 2024

CONCLUSION

Reinforcement with *flowable* resin increases RUC when compared to conventional bonding.

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