

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

**Kálita Cristina Seabra<sup>1</sup>**

**Daniele Vilela Costa<sup>2</sup>**

**Geovanna Mota Sanchez<sup>3</sup>**

**Jhullia Lopes Leão<sup>4</sup>**

**Marco Aurelio De Carvalho<sup>5</sup>**

**Priscilla Cardoso Lazari<sup>6</sup>**

**Allisson Filipe Lopes Martins<sup>7</sup>**

**Universidade Evangélica de Goiás – UniEVANGÉLICA<sup>1234567</sup>**

### ABSTRACT

Bond failures between orthodontic devices and dental enamel are frequent 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 device seems 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 dental 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; Group 3 – Transbond XT + reinforcement with Forma conventional resin. The specimens were subjected to shear testing using a universal testing machine with a knife-blade tip and a 0.5 mm/min speed. The force required for shearing was greater in Group 2 when compared to Group 1. There was no statistically significant difference when comparing Groups 1 and 3, or 2 and 3. RUC was greater in Group 2 when compared to Group 1. Reinforcement with flowable resin increases 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 glued to the tooth surface that transmit orthodontic forces to the tooth, enabling tooth movement. In this sense, 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 conditioning of the tooth surface, have been proposed (HADROUS et al., 2019; MILLETT et al., 2011; OZTURK et al., 2008). Adhesion failures are frequent 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 molars is approximately 11%

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

Despite the ease of bonding orthodontic accessories, failure of the tubes' adhesion or their spontaneous removal by the professional can damage 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 accessory's adhesion strength to the tooth have been proposed, thus avoiding rebonding.

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 objective of this study was to evaluate the adhesion strength between orthodontic adhesive and dental enamel, in teeth that underwent and did not undergo bonding reinforcement procedures, by increasing the 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 bonding method for the orthodontic tubes was based on the work of Veiga-Jardim et al. (2020). For Group 2, reinforcement was performed with a high-load nanohybrid flow-type resin. The resin was applied using an applicator tip to the occlusal surface of the tube and polymerized for 20 seconds. For Group 3, reinforcement was performed with Forma nanohybrid resin (Ultradent), in shade A2, also polymerized for 20 seconds. After gluing the tubes, the specimens were kept in distilled water for 24 hours.

A Microtensile universal testing machine, model OM150 (Odeme, Luzerna, Santa Catarina, Brazil), was used for the mechanical testing and measurement of the Shear Bond Strength (SWS). The knife-blade tip was used at a speed of 0.5 mm/min and a force of 100 kgF. The tip was positioned 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 than in Group 1, and Group 3 presented a lower RUC than Group 1 (Table 1). Most cases demonstrated a mixed fracture between the resin and the bracket.

Table 1. Shear Bond Strength

Group	Strength (kgF)	Strength (Newton)	Area (mm <sup>2</sup> )	RUC (Mpa)
Transbond	9,16 (5,07) <sup>A</sup>	89,83 (49,75) <sup>A</sup>	17,48 (1,75) <sup>B</sup>	5,14 (2,88) <sup>A,B</sup>
Transbond + Flow	10,30 (2,96) <sup>A</sup>	101,05 (29,08) <sup>A</sup>	18,00 (2,89) <sup>C</sup>	5,72 (1,84) <sup>A</sup>
Transbond + Convencional	8,29 (3,77)	81,32 (36,95)	20,52 (3,83) <sup>B,C</sup>	4,04 (1,85) <sup>B</sup>

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

## CONCLUSION

Reinforcement with flow resin increases RUC when compared to conventional bonding.

## ACKNOWLEDGEMENTS

UniEVANGÉLICA, for the PIBIC scholarship granted to student Kalita Cristina Seabra.

## REFERÊNCIAS BIBLIOGRÁFICAS

ALMOSA, N. A. et al. Incidence of orthodontic brackets detachment during orthodontic treatment: a systematic review. *Pakistan Journal of Medical Sciences*, v. 34, n. 3, p. 744-750, 2018.

DUDÁS, C. et al. Clinical bracket failure rates between different bonding techniques: a systematic review and meta-analysis. *European Journal of Orthodontics*, v. 45, n. 2, p. 175-185, 2022.

HADROUS, R. et al. Evaluation of shear bond strength of orthodontic molar tubes bonded using hydrophilic primers: an in vitro study. *International Orthodontics*, v. 17, n. 3, p. 461-468, 2019.

JANISZEWSKA-OLSZOWSKA, J. et al. Effect of Orthodontic Debonding and Adhesive Removal on the Enamel – Current Knowledge and Future Perspectives – a Systematic Review. *Medical Science Monitor*, v. 20, p. 1991- 2001, 2014.

JUNG, M. H. et al. Survival analysis of brackets and tubes: a twelve-month assessment. *The Angle Orthodontist*, v. 84, n. 6, p. 1034-1040, 2014.

KHAN, H. et al. Bracket Failure in Orthodontic Patients: the incidence and the influence of different factors. *Biomed Research International*, v. 2022, p. 1- 6, 2022.

MILLETT, D.T. et al. Adhesives for bonded molar tubes during fixed brace treatment. *The Cochrane Database of Systematic Review*, v. 6, p. CD008236, 2011

MOHEBI, S; SHAFIEE, H. A.; AMELI, N. Evaluation of enamel surface roughness after orthodontic bracket debonding with atomic force microscopy. *American Journal of Orthodontics and Dentofacial Orthopedics*, v. 151, n. 3, p. 521-527, 2017.

OZTURK, B. et al. Influence of different tooth types on the bond strength of two orthodontic adhesive systems. *The European Journal of Orthodontics*, v. 30, n. 4, p. 407-412, 2008.

PANDIS, N.; POLYCHRONOPOULOU, A.; ELIADES, T. A comparative assessment of the failure rate of molar tubes bonded with a self-etching primer and conventional acid-etching. *World Journal of Orthodontics*, v. 7, n. 1, p. 41- 44, 2006.

PINZAN-VERCELINO, C. R. M. et al. In vitro evaluation of an alternative method to bond molar tubes. *Journal of Applied Oral Science*, v. 19, n. 1, p. 41-46, 2011.

PONT, H. B. et al. Loss of surface enamel after bracket debonding: an in vivo and ex-vivo evaluation. *American Journal of Orthodontics and Dentofacial Orthopedics*, v. 138, n. 4, p. e1-387.e9, 2010.



VEIGA-JARDIM, A. F. et al. Evaluation of bond strength of molar orthodontic tubes subjected to reinforcement with flowable and bonding resins. *Journal of Orofacial Orthopedics / Fortschritte Der Kieferorthopädie*, v. 81, n. 5, p. 350-359, 2020.