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Differential bonds degradation of two resin-modified glass-ionomer cements in primary and permanent teeth

Marcela Marquezan[a], *Ticiane Cestari Fagundes*[b], *Manuel Toledano*[c], *Maria Fidela de Lima Navarro*[b], *Raquel Osorio*[c,*]

[a] *Departament of Orthodontics and Pediatric Dentistry, Universidade de São Paulo - USP; Avenida Professor Lineu prestes, 2227, Cidade Universitária, São Paulo - SP, Brazil*

[b] *Department of Dental Materials, Endodontics and Operative Dentistry, Bauru School of Dentistry, University of São Paulo, Brazil; Alameda Dr.Octávio Pinheiro Brisolla, 9-75, Vila Universitária, Bauru, SP - Brazil*

[c] *Department of Dental Materials, School of Dentistry, University of Granada Colegio Máximo. Campus de Cartuja s/n, Granada, Spain E-18071*

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ABSTRACT

Objectives: To evaluate the effect of chemical degradation on bond strength of resin-modified glass-ionomer cements bonded to primary and permanent dentin.

Methods: Class I cavities of permanent and primary extracted human molars were restored with two resin-modified glass-ionomer cements: Fuji II LC and Vitremer, and stored in water for 24 h. Half samples were immersed in 10% NaOCl aqueous solution for 5 h. Teeth were sectioned into beams and tested for microtensile bond strengths. Results were analyzed with multiple ANOVA and Tukey's tests ($p < 0.05$). Analysis of debonded surfaces was performed by SEM.

Results: 24 h bond strengths for Vitremer and Fuji II LC were similar. For Fuji II, bond strength values were higher for primary than for permanent dentin. Vitremer bond strength was similar for both. Chemical degradation did not affect Fuji II LC bond strength to dentin. However, decreases in bond strength were found for Vitremer groups after NaOCl immersion. Signs of glass ionomer–dentin interaction were evident by SEM analysis for Fuji II LC specimens.

Conclusions: Vitremer and Fuji II presented similar bond strength at 24. Vitremer dentin bonds were prone to chemical degradation. Fuji II LC–dentin bonds showed typical features of glass-ionomer dentin interaction at the bonded interfaces, and were resistant to *in vitro* degradation.

1. Introduction

There are substantial microstructural differences between permanent and deciduous dentin. Primary dentin has higher tubule density and diameter, resulting in a reduced area of intertubular dentin available for bonding.[1] Chemically, primary dentin seems to be more reactive to the acidic conditioners,[2,3] which could be explained by the reduced degree of mineralization observed in primary dental hard tissues.[4,5] Due to these differences, most of the used protocols for dentin bonding are not as effective when applied to primary dentin as they are on permanent dentin.[6,7]

Glass ionomer cements are usually selected for restoring primary teeth. The application of weak acids is required, in

* *Corresponding author*. Tel.: +34 958 243788.
E-mail address: toledano@ugr.es (R. Osorio).

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order to clean the tooth surface, remove the smear layer, and expose collagen fibrils, allowing glass-ionomer components to inter-diffuse and establish a micro-mechanical entanglement with dentin.[8] Furthermore, chemical bonding may be attained, by ionic interaction of the carboxyl groups of the polyalkenoic acid with calcium ions of remnant hydroxyapatite that remain attached to the collagen fibril.[9–11] Resin-modified glass-ionomer cements (RMGIC) are particularly promising for restorative indications.[12] Chemical and/or hydrolytic degradation has been previously reported for resin–dentin bonded interfaces.[13–18] If RMGIC–dentin bonded interfaces are also prone to these degradation processes remains to be ascertained.[19]

The purpose of this study was to ascertain RMGICs–dentin bonds resistance to degradation. The null hypothesis to be tested is that there are no differences in bond strength resistance to degradation when using two different RMGICs on primary or on permanent dentin.

2. Material and methods

2.1. *Specimens preparation*

Twelve of each primary and permanent non-carious human molars were used in this study. The human molars were obtained after the institutional informed consent from all donators. The research was approved by the Research Ethics Commission. The teeth were cleaned with pumice/water slurry, rinsed and stored in distilled water in a refrigerator (4 °C) until use. The pulp chambers of crowns were sealed with composite resin and their cusps flattened with 220-grit abrasive paper. Occlusal Class I cavities (7 mm × 5 mm × 2 mm deep) were prepared using a high-speed handpiece with a cylindrical medium-grit (100 μm) diamond bur (#842, Komet, Lemgo, Germany) under water irrigation. Each diamond point was replaced every five preparations.

The teeth were randomly divided into 8 groups. Two RMGICs were tested: Fuji II LC (GC Corporation, Tokyo, Japan) and Vitremer (3 M ESPE, Seefeld, Germany). Materials were applied following the manufacturers' instructions (Table 1). Dentin was dried gently with absorbent paper when Fuji LC was applied. For Vitremer group, dentin was carefully air dried in order to maintain a moist dentinal surface. A Translux EC (Kulzer GmbH, Bereich Dental, Wehrheim, Germany) halogen light-curing unit was used after material insertion. The output intensity was monitored with a Demetron Curing Radiometer (Model 100, Demetron Research Corporation, Danbury, CT, USA). A minimal output intensity of 600 mW/cm^2 was required for the experiments. Specimens were stored for 24 h at 37 °C. The occlusal surfaces of the restorations were ground in order to assure that the bonded enamel-restorative material interfaces were exposed and specimens were stored as RMGIC-bonded teeth: (1) 24 h immersed in distilled water, (2) 5 h immersed in a 10% aqueous solution of sodium hypochlorite, followed by rinsing in water for 1 h.

2.2. *Microtensile bond strength (MTBS) testing*

After each storage period, the bonded teeth were vertically sectioned into serial slabs and further into beams with cross-sectional areas of approximately 1 mm^2. Specimens were attached to a modified Bencor Multi-T testing apparatus (Danville Engineering Co., Danville, CA, USA) with a cyanoacrylate adhesive (Zapit, Dental Ventures of America Inc., Corona, CA, USA) and stressed to failure in tension using an

Table 1 – Restorative materials tested in the experimental groups.

Materials	Components	Mode/steps of application	Manufacturer (batch number) (power/liquid ratio)
Fuji II LC	Powder: fluoro-aluminosilicate glass Liquid: acrylic-maleic acid copolymer, hydroxyethyl methacylate (HEMA), water, camphoroquinone	(1) Apply 10% of polyacrylic acid solution for 20 s, using a light scrubbing motion (2) Rinse thoroughly and gently dry with absorbent paper (3) Hand-mix manipulation (4) Insert into a cavity using a syringe injector in a single increment (5) Light cure for 40 s (6) Apply finishing gloss and light-cure for 20 s	GC Corporation, Tokyo, Japan (0604191) (3.0:1.0)
Vitremer	Primer: HEMA, ethyl alcohol, Vitrebond copolymer Powder: fluoro-aluminosilicate glass, potassium persulfate, ascorbic acid Liquid: polyacrylic acid copolymer, HEMA, water, carboxylic acid copolymer	(1) Apply primer for 30 s, using a light scrubbing motion. Apply mild air stream for 15 s (2) Light cure for 20 s (3) Hand-mix manipulation (4) Insert into a cavity using a syringe injector in a single increment (5) Light cure for 40 s (6) Apply finishing gloss and light-cure for 20 s	3M ESPE, Seefeld, Germany (20061011) (2.5:1.0)