The Influence of Silane on the Interfacial Fracture Toughness of PICNs with Resin Cement

M Eldafrawy [1], L Greimers [1], J-F Nguyen [2,3], M Sadoun [4], A Mainjot [1,5]

[1] *Dental Biomaterials Research Unit (d-BRU), Institute of Dentistry, University of Liège, (ULg), Liège, Belgium.* [2] *UFR d'Odontologie, Université Paris Diderot, Paris, France.* [3] *PSL Research University, Chimie ParisTech-CNRS, Institut de Recherche de Chimie Paris, Paris, France.* [4] *MaJEB sprl, Liège, Belgium.* [5] *Department of Fixed Prosthodontics, Institute of Dentistry, University of Liège Hospital (CHU), Liège, Belgium.*

INTRODUCTION: CAD-CAM composites can be divided into 2 sub-classes according to their microstructure, Polymer Infiltrated Ceramic Networks (PICN) and Dispersed Filler (DF) materials[1]. Pre-treatment procedures including creation of micro-roughness using hydrofluoric acid (HF) for micro-mechanical retention and silanization for chemical bonding are commonly reported to be necessary to bond PICNs to the resin cement. On the other hand, PICNs were shown to exhibit a retentive polymer-based honeycomb structure when etched, which promotes the micro-mechanical bond but could reduce the need of silane since the inorganic part of the material surface is removed by the etching procedure. The objective of this study was to evaluate the influence of silane on Interfacial Fracture Toughness (IFT) at mouth temperature of composite cement with PICN versus DF materials, after HF etching and upon thermocycling aging. The hypothesis was that silane pre-treatment has no effect on the IFT of composite cement with PICNs.

METHODS: Experimental PICN blocks were prepared by partially sintering Vita Mark II glass-ceramic powder (73.8% vol) then infiltrating it under HT-HP (180°C-300 MPa) with UDMA and di-tert-amyl peroxide initiatior. Experimental DF blocks were composed of 70.4 wt% fillers in a matrix of UDMA and TEGDMA polymerized under HT-HP. Blocks were cut and polished into half prisms (6±0.1 mm) which were bonded to their counterparts with an experimental light-cure resin cement, composed of UDMA and TEGDMA (2:1 mass ratio) with 25 wt% fillers and 1 wt% and 0.5 wt% 4,N,N-trimethylanilin and camphorquinone, respectively. All prisms were pre-treated with 5% HF etching prior to bonding and were divided into two groups; with and without silanization (n=30 per group). Cement thickness was adjusted to 50µm with a custom-design system. All samples were subjected to thermocycling (10,000 cycles) and tested for IFT using the Notchless Triangular Prism (NTP) test in a water bath at 36°C. The results were analyzed by one- and two-way ANOVA followed, if warranted, by Scheffé's multiple mean comparisons (α=0.05). Weibull parameters were calculated for IFT.

RESULTS: PICN with silane pre-treatment (PICN-S) gave a significantly higher IFT compared to PICN without silane (PICN-C) and compared to the groups of DF, with and without silane (DF-S and DF-C). Silane pretreatment had no significant effect on DF IFT. Two-way ANOVA revealed the influence of the microstructure (PICN versus DF), silane pre-treatment and both combined on IFT. In addition, Weibull modulus of PICN IFT were higher than those of DF IFT.

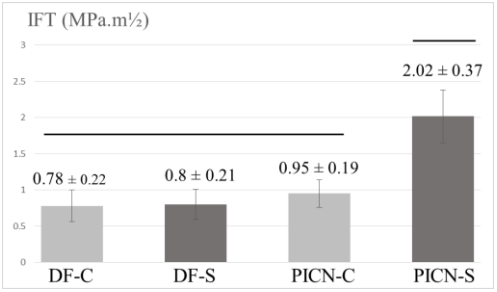

Fig. 1: Bar graph (mean ± SD) of the IFT of the tested materials. Bars connected with lines were not statistically different

DISCUSSION & CONCLUSIONS: This study highlighted the importance of silane pre-treatment on the bonding effectiveness of PICN CAD-CAM materials, whereas it had no influence on DF when etched. Further research should focus on silane effectiveness mechanism, a hypothesis being that it increases surface wettability.

REFERENCES: [1]A.K. Mainjot, N.M. Dupont, J.C. Oudkerk, et al. (2016) *J Dent Res* 95(5):487-49.