Influence of Delayed Placement and Resin Matrix on Composite-Composite Interface Strenght

Suvi Vallittu, Lippo Lassila, Juliana Paski, Sufyan Garoushi, Pekka Vallittu
Department of Biomaterials Science and Turku Clinical Biomaterials Centre, TCBC, Institute of Dentistry, University of Turku Finland

Objectives

The aim was to investigate the effect of delay time in composite placement and resin matrix type on the shear bond strength (SBS) between two successive composite layers made from the same material.

Materials and methods

Three experimental composites were prepared by mixing 79 wt% of particulate filler with 21 wt% of different combinations of dimethacrylate-based resin matrices (UDMA/TEGDMA; BisGMA/TEGDMA BisEMA/UDMA/TEGDMA). Fifteen groups of specimens were prepared (n=6/group) having a cured composite as substructure layer and then the successive surface composite layer was applied at various time intervals following light irradiation of the substructure layer (0 minute, 10 minutes, 1 hour, 24 hours, and 72 hours).

Materials and methods

After two-day of dry storage at 37°C, bond strength was measured with so-called shear bond strength test (SBS) in which the interfacial adhesion layer was stressed predominantly with shear type of stress. The measurement was done with a universal testing machine (Lloyd; Lloyd Instruments, Fareham, UK), and failure modes were visually analyzed. SBS values were statistically analyzed with a Two-way analysis of variance (ANOVA) followed by Tukey HSD test (α=.05). In addition, the oxygen inhibition depth of each composite was measured immediately after curing. Measurement was done by using a Leica DMLB microscope (Leica, Wetzlar, Germany) at a magnification of x20 with a calibrated disk. Images of inhibition layer were taken using a computer imaging program Toupview (Hangzhou ToupTek Photonics Co., Zhejiang, China).

Results

SBS values ranged from 24.5 ± 3 to 10.3 ± 2.4 MPa for all specimens. The mean SBS decreased ($p<0.05$) when the composite–composite interface was time delayed more than 1 hour. However, the effect was material dependent. Resin matrix type has a significant ($p<0.05$) effect on SBS values. Cohesive failure in substructure layer was found to be predominant in all specimens.

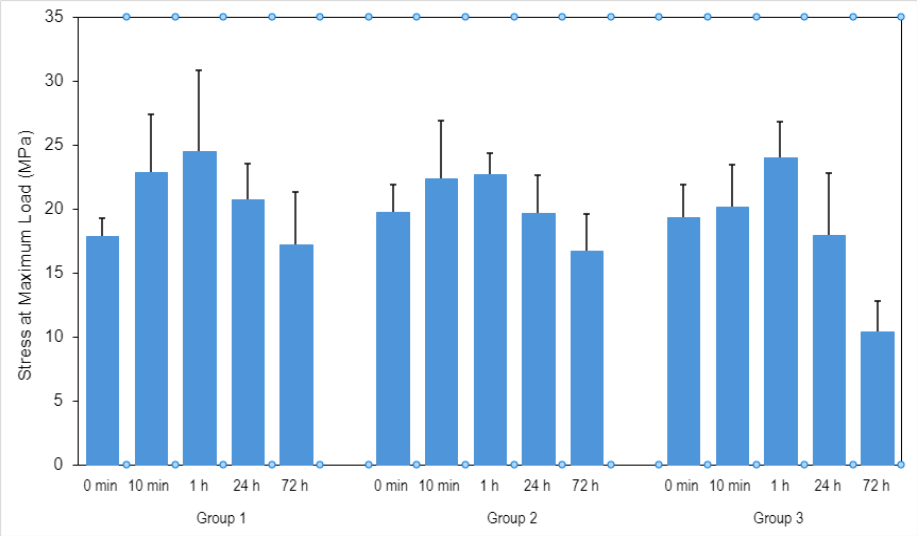

Fig. 1. Means and standard deviations of SBS for UDMA/TEGDMA (group 1), BisEMA/UDMA/TEGDMA (group 2) and BisGMA/TEGDMA (group 3).

Results

The Inhibition depth was greatest in BisEMA/UDMA/TEGDMA with 36 µm. BisGMA/TEGDMA had an inhibition depth of 34 µm and UDMA/TEGDMA had the lowest inhibition depth with 29 µm.

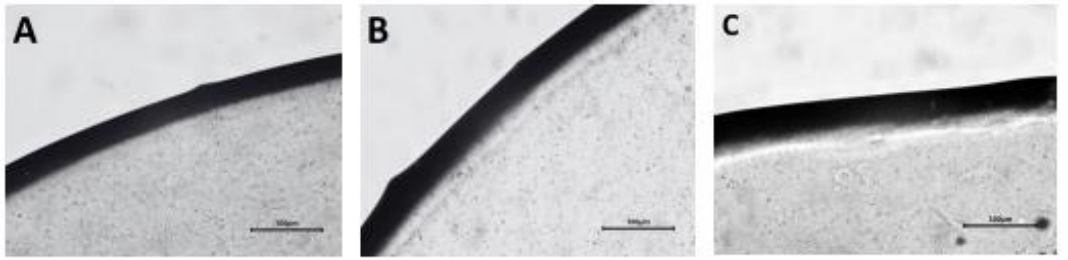

Fig. 2. Microscopy images of the oxygen inhibition layer in UDMA/TEGDMA (A), BisEMA/UDMA/TEGDMA (B) and BisGMA/TEGDMA (C).

Conclusions

The data suggests that the shear bond strength between two successive composite layers could deteriorate after a one-hour placement delay.

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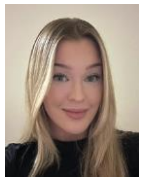

savall@utu.fi