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The Effects of Solutions and Surface Treatments on the Shear Bond Strength Between Aged 3D-Printed Provisional Restorations and Repair Materials

Natthamol Aroonmanakun[1], Lapon Mutthapong[2], Boonchai Chaoklaiwong[2], Pisaisit Chaijareenont[2], Piriya Yavirach[2], Apichai Yavirach[2]

[1]Master of Science Program in Dentistry, Department of Prosthodontics, Faculty of Dentistry, Chiang Mai University, Thailand
[2]Department of Prosthodontics, Faculty of Dentistry, Chiang Mai University, Thailand

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Corresponding Author:
Apichai Yavirach, Department of Prosthodontics, Faculty of Dentistry, Chiang Mai University, Chiang Mai 50200, Thailand
E-mail: apichai.y@cmu.ac.th

Abstract

Objectives: To evaluate the effects of different solutions, surface treatments, and repair materials on the shear bond strength (SBS) between aged 3D-printed provisional materials and repair materials.

Methods: This study printed samples with 3D-printed resin and divided them into 16 groups (n=10): non-immersion and three solutions (40% ethanol, heptane, and cola) × two surface treatments (no abrasion [NA] and sandpaper and sandblasting [SP&SB]) × two repair materials (Poly(methyl methacrylate) [PMMA] and bis-acryl). The samples were immersed in the solutions for six days and then surface-treated. Nine samples were randomly selected for surface examination, including surface roughness, surface characteristics, and contact angle. Then, they were bonded with the repair materials, followed by 2,500 cycles of thermocycling. SBS was determined using a universal testing machine, and failure modes were determined by stereomicroscope. A three-way ANOVA was conducted to evaluate the effects of the solution, surface treatment, and repair material on SBS. SBS, surface roughness, and contact angle were compared among groups using one-way ANOVA, followed by post-hoc Tukey's tests.

Results: The three-way ANOVA analysis revealed a significant interaction among solutions, surface treatments, and repair materials ($p<0.05$). The mean SBS did not differ significantly between immersed and non-immersed groups. Among the solutions, surface treatments, and repair materials, SBS significantly increased after SP&SB surface treatment ($p<0.05$) and was significantly higher in the bis-acryl group than in the PMMA group ($p<0.05$). Cohesive failure was primarily observed when SP&SB and/or bis-acryl was applied. The mean Ra and contact angle were significant different after applied SP&SB ($p<0.05$). Additionally, SP&SB groups exhibited an irregular surface with multiple porosities.

Conclusions: The solutions alone did not significantly affect the SBS between aged 3D-printed provisional materials and two repair materials. However, SBS differed significantly after SP&SB treatment of the aged 3D-printed provisional materials and/or when they were repaired with bis-acryl.

Keywords: bis-acryl, food-stimulating agents, PMMA, provisional crown, sandblasting