Direct Laser writing based surface texturing for enhanced adhesion between zirconia (3Y-TZP) and resin-matrix cement

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Objective: To evaluate the influence of short-pulse laser (SPL) surface texturing of 3 mol % Yettria-tetragonal zirconia polycrystalline (3Y-TZP) on shear bond strength with resin-matrix cements.

Methods: Zirconia (3Y-TZP) green compacts received two SPL patterns: LD35 - Squared pattern lines 35 µm spacing (0.6 W,128 mm/s); LD10 - Squared pattern lines 10 µm spacing (0.06 W,256 mm/s) and sintered zirconia samples received two treatments: SB - controlled blasting of alumina particles (Al_2O_3); SC - controlled blasting of silica (SiO_2) coated alumina particles. Surface energy, surface roughness, wettability (contact angle: water (H_2O); Diiodomethane (CH_2I_2)) is evaluated for each group (n = 12/group). Treated samples from all groups were ultrasonically cleaned and cemented to resin-matrix cement using primers. The cylindrical shape cements bonded at the center of 3Y-TZP samples were either stored for 24 h at 37º C or thermocycled (5-55 º C, 6000 cycles) and shear bond strength (SBS) was performed subsequently. *Results:* The surface roughness was highest in DL35 (2.1 ± 0.3)……. .The lowest and highest contact angle (water) was produced by SC (27.30 ± 4.66) and SB (61.44 ± 2.97) respectively. Similarly the lowest and highest contact angle (Diiodomethane) was produced by LD10 (26.93 ± 2.85) and SC (36.76 ± 0.27) respectively. Surface free energy was highest for SC (65.30 ± 2.06) and lowest for SB (56.15 ± 1.19). The two lasers groups: LD10 (9.16 ± 1.55) and LD35 (8.89 ± 2.18) produced higher SBS than SC (6.46 ± 1.84) group. The highest SBS was produced by SB (9.69 ± 3.93) however the highest error was also incurred in this group. Thermocycling (TC) reduced the SBS of all groups. The highest SBS after TC was shown by LD35 (8.49 ± 2.02) and the lowest by SB (5.97 ± 2.43). The reduction in SBS was significant in SB and both laser groups retained higher SBS than SB and SC, there was an increase of SBS in SC group after TC.