Title	Resin-Zirconia bonding promotion in vitro with a zirconate coupling agent
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RESIN-ZIRCONIA BONDING PROMOTION IN VITRO WITH A ZIRCONATE COUPLING AGENT

OBJECTIVE: Silane-aided bonding is widely acknowledged, but new coupling agents may be needed for enhanced bonding. The aim of this study was to evaluate *in vitro* the effect of a zirconate coupling agent application on the bonding between a flowable resin-composite and zirconia. It was hypothesized that the zirconate coupling agent would promote resin-composite adhesion better than using a commercial primer on a tribochemically silica-coated zirconia surface.

METHOD: Various amounts (0.2, 0.4, 0.6, 0.8 and 1.0 vol%) of an organo-zirconate, a neoalkoxy zirconate coupling agent, Zr(IV)-2,2(bis-2-propenolatomethyl)- butanolato-tris-2-methyl-2-propenoato-O (NZ-33, Kenrich Petrochemical, USA) were diluted in absolute ethanol and applied onto silica-coated and cleansed zirconia surfaces (Upcera, Liaoning Upcera). Silica-coating (3M ESPE, Germany) was carried out as instructed by the manufacturer. Next, a flowable resin-composite (StickFlow, StickTech, Finland) stubs (n=10) were light-cured onto zirconia surfaces, and then the shear bond strength (SBS) was measured. Initial bond strength was recorded. The interface chemistry was evaluated by using electron dispersive x-ray analysis (EDX) before and after treatments. A commercial primer (Metal/Zr Primer, Ivoclar-Vivadent, Liechtenstein) and 'no primer' were used as controls. Surface roughness was measured.

RESULT: ANOVA revealed that 0.2-1.0vol% content of the zirconate coupling agent (mean values 9.94-12.82MPa) showed significantly higher SBS ($p<0.05$) than those not treated specimens. With a 0.6vol% zirconia coupling agent a non-significant difference in SBS was observed ($p=0.96$). The zirconate also produced a significantly greater shear bond strength than with 'no primer' (5.17MPa, $p<0.05$). After silica-coating the surface roughness Ra was 0.49 (SD 0.2). The predominant mode of failure was adhesive. Electron dispersive x-ray (EDX) analysis at the surface revealed changes on elemental distribution of C1s, O1s, Si1s and Zr2p on zirconia surfaces.

CONCLUSION: Tribochemical silica-coating followed by application of a zirconate coupling agent might be a new option for more durable bonding on resin-composites to zirconia surfaces.