

Effect of Surface Treatment Protocols on Bonding of Resin Luting Agents to Zirconia Based Ceramics

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Abstract

Purpose: Establishing a reliable adhesive bond to zirconia-based materials is always a challenge. The purpose of this study was to evaluate the micro-shear bond strength of conventional and self-adhesive resin cements to zirconium oxide ceramic after different surface treatments.

Material and Methods: Yttrium stabilized zirconia ceramic plates of dimensions 10 × 10 × 1 mm thickness were fabricated by a CAD/CAM process. The plates were divided into three groups according to surface treatments performed: (1) no treatment (NT); (2) airborne-particle abrasion with 110-µm alumina particles (SB); (3) silica coating with Cojet system (CT) (3M/ESPE, USA). Each group was then divided into two subgroups according to type of resin cement; Panavia F 2.0 (Kuraray, Japan) and RelyX Unicem (3M/ESPE, USA). Ten composite resin cylinders (0.75 × 0.5 × 0.5 mm height) were bonded to each ceramic plate (N = 10), and each specimen was subjected to a shear load at a crosshead speed of 0.5 mm/min until fracture occurred. The fracture sites were examined with scanning electron microscopy (SEM) to detect the mode of failure. Data were statistically analyzed using two-way ANOVA and multiple comparisons were made using Fisher's test at $p < 0.05$.

Results: Micro-shear bond strength was significantly affected by the surface treatment and by the type of resin cement. Panavia F 2.0 showed higher significant results in comparison to RelyX Unicem. Surface treatment with CT was highly significant with both cements, followed by SB and then by NT. SEM examination revealed predominantly cohesive failures within the resin cements for CT group, mixed failures within SB group and predominantly adhesive failure at the interfacial area within NT group.

Introduction

The use of high-strength zirconium oxide ceramics for oral rehabilitation has grown in recent years. It has become a material of choice for esthetic restorations, because of its unique properties and biocompatibility. CAD/CAM technology has simplified the fabrication of zirconia restorations. Additionally, adhesively bonded zirconia restorations, have recently surfaced as a conservative treatment option for minimally invasive approaches. They depend entirely on resin adhesive cementation for retention, marginal adaptation and resistance against masticatory loads [1-7].

Surface treatment is essential for bonding to ceramics. However, zirconia is resistant to hydrofluoric acid etching because of its crystallinity and the limited glassy phase (below 1%) [7-11]. As a consequence, other conditioning methods have been suggested. Airborne abrasion was reported by many studies to be an effective way of increasing the surface area and producing a degree of roughness that can lead to an acceptable resin/ceramic micromechanical interlocking [12,13].

Conclusions: The micro-shear bond strength of resin cement to partially stabilized zirconia ceramics varied significantly depending on the type of resin luting agent and surface treatment method. The tribochemical silica coating of zirconia surfaces in combination with MDP-containing resin cement (Panavia F 2.0) showed a superior performance.

