ceramics to achieve predictable and durable long-term bonds. The only methods that provided long-term durable resin bonds were either tribochemical silica coating in combination with a conventional dimethacrylate composite resin or sandblasting and a composite resin containing an adhesive phosphate monomer.

COMMENTARY

This study is already considered a classic since it was one of the first to evaluate resin bond strengths to oxide-based high-strength ceramics and the effects of long-term water storage and thermocycling to demonstrate the susceptibility of the bond between composite resin and high-strength ceramics to hydrolytic and thermal influences. The dramatic decrease of resin bond strengths to high-strength ceramics after simulated aging is in contrast to the resin bonds achieved to silica-based ceramics. The authors demonstrated that such aging parameters are indispensable tools to identify superior bonding methods and materials, especially for high-strength ceramic materials. Conventional dimethacrylate composite resin luting agents and silane couplers cannot provide long-term durable resin bonds to glass-infiltrated alumina. This study showed that some methods and materials that provide strong and durable bond strengths to metal alloys (ie, tribochemical silica coating and a phosphate-modified resin cement) are highly effective for glass-infiltrated aluminum oxide ceramics.

SUGGESTED READING

Blatz MB, Sadan A, Kern M. Resin-ceramic bonding—a review of the literature. J Prosthet Dent 2003; 89:268–274.

Kern M, Thompson VP. Sandblasting and silica coating of glass-infiltrated alumina ceramic: volume loss, morphology, and changes in the surface composition. J Prosthet Dent 1994; 71:453–461.

Ozcan M, Alkumru HN, Gemalmaz D. The effect of surface treatment on the shear bond strength of luting cement to a glass-infiltrated alumina ceramic. Int J Prostho dont 2001; 14:335–339.

SHEAR BOND STRENGTH OF A RESIN CEMENT TO DENSELY SINTERED HIGH-PURITY ALUMINA WITH VARIOUS SURFACE CONDITIONS

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ABSTRACT

Objective: This study evaluated the effect of different surface treatments on the surface morphology of densely sintered high-purity alumina and the influence of these treatments on the shear bond strength of a resin cement to this core material.

Materials and Methods: Forty cylindric samples were fabricated from densely sintered high-purity aluminum-oxide ceramic (Procera®, Nobel Biocare AB, Gothenburg, Sweden) and divided into four groups of different surface treatments: (1) etching with hydrofluoric acid (9.6%) for 2 minutes followed by rinsing with air/water spray for 30 seconds; (2) sandblasting with a microetcher for 15 seconds using 50 μm alumina particles; (3) roughening with a diamond bur and etching with 37% phosphoric acid for 2 minutes followed by rinsing for 30 seconds with an air/water spray; (4) no treatment (control). The surfaces of all specimens were examined with an SEM to determine surface morphology.

Four additional groups of specimens (n = 10) were prepared as described above and bonded with a dual-cure resin cement (EnForce®, Dentsply Caulk, Milford, DE, USA). The bonding areas were isolated and coated with EnForce silane coupling agent and EnForce bonding agent. After bonding, all specimens were stored at 100% humidity at room temperature for 1 week before shear bond strength was tested in an Instron® (Instron Corp, Canton, MA, USA) testing machine.

Results: The SEM micrographs of the densely sintered high-purity alumina surfaces revealed a relatively rough and distinct microstructure

in the control group. Surfaces after etching with hydrofluoric acid or diamond abrasion showed similar distinct boundaries. The sharp edges, however, appeared to be blunted in the specimens that were sandblasted.

Bond strength tests identified sandblasting with alumina particles as the most effective surface treatment. Diamond-abraded specimens had higher bond strengths than those for the control group, but they were not significantly stronger than those for the hydrofluoric acid-etched group. Acid-etched samples had the weakest resin bond.

Conclusions: SEM examination of densely sintered aluminum oxide ceramic illustrated its inherent surface morphology and the influence of different surface treatment methods. Sandblasting revealed the most pronounced alterations, that is, blunting of the sharp edges typically appearing with the other surface treatment methods and the control group. Sandblasting produced the significantly highest resin bond strengths.

COMMENTARY

Densely sintered aluminum oxide ceramic is much stronger than glass-infiltrated alumina and does not contain any silica. The authors demonstrate that sandblasting alters the surface of densely sintered alumina more effectively for increased bond strengths than do conventional acid-etching and grinding. Multiple studies that included alternative testing methods and materials, simulated aging, and/or surface configurations confirmed these findings and made sandblasting the standard procedure for pretreating intaglio surfaces of bonded densely sintered alumina restorations.

SUGGESTED READING

Blatz MB, Sadan A, Arch G, Lang B. In-vitro evaluation of long-term bonding of Procera AllCeram alumina restorations with a modified resin luting agent. J Prosthet Dent 2003; 89:381–387.

Blixt M, Adamczak E, Linden L-A, Oden A, Arvidson K. Bonding to densely sintered alumina surfaces: effect of sandblasting and silica coating on shear bond strength of luting cements. Int J Prosthodont 2000; 13:221–226.

Friederich R, Kern M. Resin bond strength to densely sintered alumina ceramic. Int J Prosthodont 2002; 15:333–338.

LONG-TERM RESIN BOND STRENGTH TO ZIRCONIA CERAMIC

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ABSTRACT

Objective: This in vitro study evaluated the long-term bond strength of adhesive bonding systems to yttrium-oxide partially stabilized zirconia ceramic (YPSZ).

Materials and Methods: Industrially manufactured YPSZ disks were air abraded with 110 μ aluminum-oxide particles. Composite resin specimens were bonded to the pretreated ceramic surfaces with an alignment apparatus. Seven different surface treatment methods and bonding systems were included in this study (n = 16): Clearfil F2® (Kuraray Dental, Tokyo, Japan), Dyract Cem® (DeTrey/Dentsply, Konstanz, Germany), Kevloc® (Heraeus Kulzer, Wehrheim, Germany), Panavia® (Kuraray), Panavia 21® (Kuraray), Rocatec™ (3M ESPE, St. Paul, MN, USA), and Twinlook® (Heraeus Kulzer). Eight specimens per group were stored in distilled water at 37°C for either 3 days or 2 years and thermal cycled for 37,500 cycles between 5° and 55°C. Tensile bond strength was tested at a crosshead speed of 2 mm/min. The fractured interfaces were examined under a light microscope at ×30 magnification to determine failure modes.

Results: Conventional dimethacrylate composite resin had bond strengths that were initially low and, after the 2-year storage period, nonexistent. Specimens treated with Rocatec tribochemical coating had higher bond strengths after 3 days, which decreased by almost 50% during the storage