Silane coupling agents provide covalent chemical bonds to silica-based ceramics and have a wetting effect on roughened ceramic surfaces, facilitating the use of a bonding agent/unfilled resin. The autopolymerizing resin cement had significantly lower bond strengths than did the dual-cure resin cement. However, it could not be determined whether this was due to their specific compositions and/or curing modes. The proper combination of the components of a bonding/luting system seems to be key for predictable results. Components of different ceramic bonding systems might not be compatible and should therefore not be interchanged. The varying effects of thermocycling on the performance of the different material combinations demonstrate the necessity for such parameters to simulate intraoral conditions and to evaluate the durability of resin bonds.

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BOND DURABILITY OF THE RESIN-BONDED AND SILANE-TREATED CERAMIC SURFACE

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ABSTRACT

Objective: This study evaluated methods to improve the bond strength of silanes to silica-based ceramics to eliminate the hazardous process of hydrofluoric acid application.

Materials and Methods: A leucite-reinforced feldspathic ceramic was fired onto NiCr alloy rods. The ceramic surfaces were uniformly wet ground, polished, and ultrasonically cleaned in acetone. Two hundred ten specimens were divided into seven groups of different silane-solution application methods:

1. Ceramic immersed in silane for 1 minute and dried at room temperature with compressed air for 15 seconds
2. Ceramic immersed in silane for 1 minute and dried at 100°C in a furnace for 2 minutes
3. Silane applied for 60 seconds with a brush and dried at room temperature with compressed air for 15 seconds
4. Same as group 3 but heated to 100°C for 2 minutes
5. Same as group 3 but hot-air dried at 50 ± 5°C for 15 seconds
6. Same as group 5, followed by rinsing of the specimens with boiled water at 80°C for 15 seconds and hot-air drying for 30 seconds
7. Same as group 6, with the additional application of a thin layer of unfilled resin by brush

Three additional groups of 30 specimens were fabricated for comparison with the results of the polished ceramic surfaces:

8. Same as group 7, then grit blasted with 50 μm aluminum oxide particles
9. Same as group 7, then etched with 10% hydrofluoric acid for 2 minutes
10. Same as group 7, then grit blasted and etched as with groups 8 and 9

All specimens were bonded with a dual-cured luting resin. The durability of the bond was evaluated by water storage at 37°C for up to 3 months, thermal cycling, and storage in 100°C water for 24 hours. Bond strengths were evaluated with a tensile testing device.

Results: Comparisons of the silane application procedures showed

that the tensile bond strength for group 7 was significantly higher than that for groups 1, 2, 3, 4, and 6, but not for group 5. No significant difference was found between the polished (group 7) and the roughened (groups 8–10) specimens. Water storage or thermocycling had a significant effect on the bond to the roughened test groups but not to the polished one. Bond strengths of the etched, grit blasted, and combination groups gradually increased after water storage and after thermocycling. The silane bond was also capable of resisting hydrolytic attack in boiling water.

Conclusion: The authors conclude that a durable resin-ceramic tensile bond can be obtained with appropriate silane application without the need for hydrofluoric acid etching of the ceramic surface.

COMMENTARY

A current trend in laboratory bonding studies is a shift away from the traditional shear test methods and toward modified tensile tests to minimize nonuniform stresses at the bonding interface. Concurrent findings illustrate the importance of the chemical component of the resin-ceramic bond and conclude that silane treatment may play a greater role than surface roughening. The results of this study offer excellent validation for this trend and indicate that certain silane application methods might eliminate the need for hydrofluoric acid etching. The large discrepancies between the results of different studies raise the question of the clinical relevance of in vitro bond strength testing methods in general. None of the conventional bond strength tests can exactly simulate the various stress patterns and modes of failure as they occur in the oral cavity. Improved testing methods and application of clinically relevant influencing parameters may help to better understand these patterns. Nevertheless, laboratory tests are indispensable tools to identify superior materials and techniques in a standardized manner before their reliability is evaluated in clinics.

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ARE ADHESIVE TECHNOLOGIES NEEDED TO SUPPORT CERAMICS? AN ASSESSMENT OF THE CURRENT EVIDENCE

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ABSTRACT

Objective: This article reviews the effects of adhesive technology on the success of all-ceramic restorations in laboratory and clinical studies.

Materials and Methods: The authors reviewed laboratory and clinical studies of the influence of cementation media selection on the performance of all-ceramic restorations.

Results: Conventional testing methods reveal large variations in the fracture strengths of materials used for all-ceramic restorations, such as dispersion-strengthened, glass-infiltrated, castable, pressable, and machinable ceramics. However, the annual clinical failure rate reported in the literature is remarkably consistent at about 3%. This rate indicates little correlation between the average fracture strength of ceramics and their resultant clinical performance and longevity. Several laboratory and clinical studies have emphasized the effects of adhesive technologies on