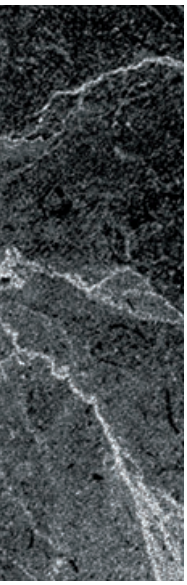

Ask the Experts

ADHESIVE CEMENTATION OF HIGH-STRENGTH CERAMICS

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QUESTION: In cases where an alumina or zirconia ceramic restoration must be bonded to the tooth structure for increased retention or for some other reason, how should the bonding surfaces be prepared and what cement(s) should be used?

ANSWER: One of the driving forces behind the development of high-strength ceramic materials was the ability to fabricate an all-ceramic crown that does not require resin bonding for final insertion of that restoration. Aluminum oxide and zirconium oxide ceramics, the preferred materials for high-strength ceramic copings, provide inherent strength that allows for conventional cementation (e.g., FujiCEM, GC America, Alsip, IL, USA; RelyX Luting Plus, 3M ESPE, St. Paul, MN, USA) without compromising functional integrity.

However, in the event of compromised retention or marginal seal, even high-strength ceramic crowns might benefit from adhesive bonding with a composite resin luting agent. Also, esthetic and functional advantages have pushed the envelope of clinical indications of high-strength ceramic materials to restorative options that require resin bonding for clinical success (e.g., laminate veneers, all-ceramic resin-bonded fixed partial dentures). In any of these situations, it is important to use bonding materials and techniques that provide long-term, durable resin bonds to that specific restorative material. When bonding alumina or zirconia restorations, resin bonding to the tooth structure follows the same protocols as used for other indirect bonded restorations. The question, therefore, is how to specifically bond to alumina and zirconia materials.

First, it is important to clearly differentiate between traditional feldspathic ceramics (porcelain) and metal-oxide ceramics (alumina and zirconia). Feldspathic ceramics are mostly used as veneering porcelain, for porcelain laminate veneers, and for ceramic inlays and onlays. Strong and durable resin bonds to feldspathic ceramics are achieved by hydrofluoric (HF) acid-etching of the ceramic bonding surface for improved microretention, followed by the application of a silane coupling/bonding agent for chemical bonds and the use of a conventional composite resin luting agent as the "cement."

Unfortunately, these methods cannot provide sufficient bonds to metal-oxide ceramics. HF acid does not sufficiently alter the surfaces of high-strength ceramics, and conventional silane coupling agents cannot provide chemical bonds to these materials because of the lack of silica. The methods for bonding to metal-oxide ceramics follow the

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principles used when bonding to metal alloys. Therefore, based on the majority of the available evidence, alumina and zirconia should be resin bonded as follows:

1. activation of the ceramic surface through air-particle abrasion with a microetcher and aluminum-oxide particles. New research suggests small particles (30 μm) and low pressure (35 psi) to enhance resin bonds while minimizing surface damage.
2. application of a ceramic/metal primer that contains adhesive monomers that chemically bond to metal oxides (e.g., Clearfil Ceramic Primer or Alloy Primer, Kuraray, Tokyo, Japan)
3. application of a dual- or self-cure composite resin luting agent that preferably contains the same adhesive monomer as the primer (e.g., Panavia F 2.0, Kuraray)

Alternative methods for bonding to metal alloys and metal-oxide ceramics include tribochemical silica coating (Rocatec, 3M ESPE) and other silica-coating methods. These methods embed silica particles into the metal alloy/metal-oxide ceramic surfaces. Silane coupling and bonding agents used for conventional feldspathic porcelain can then be used to bond to the silica-modified surfaces.

The topic of resin bonding to high-strength ceramic materials has been rather neglected in the past, but it becomes more and more important with the increasing use of high-strength ceramic materials. Recent developments are geared toward reducing the number of clinical steps and eliminating surface-altering pretreatment methods when bonding alumina or zirconia. One of the drawbacks is that many commercial products are marketed simply as "alumina" or "zirconia" even though distinct differences in contents, composition (ranging from "glass infiltrated" to "densely sintered"), and fabrication processes create materials of substantially different physical and optical properties. Differences in composition (e.g., particle/grain size) and processing also can create unique internal surface morphologies, which might affect the bonding ability. In the future, manufacturers may be able to create specific surface patterns or nondestructive pretreatment methods that further enhance bond strengths to high-strength ceramic materials.

SUGGESTED READING

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Editor's Note: If you have a question on any aspect of esthetic dentistry, please direct it to the Associate Editor, Dr. Edward J. Swift Jr. We will forward questions to appropriate experts and print the answers in this regular feature.

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