

Preserving Principals of Successful Porcelain Veneers

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Abstract

Longitudinal observations of etched porcelain bonded restorations reveal an overwhelming success if the basic principles of minimal invasive procedure and preservation of enamel are followed. Porcelain veneers are not a substitute for orthodontic treatment. Clinical observations suggest that limited superficially exposed dentin surrounded by sound enamel will not reduce the durability of porcelain veneers. No longitudinal study on bonding ceramic veneers entirely to dentin is available at this time. It is unlikely that any of the available dentinal adhesives are capable of providing a reliable bond long-term when used for bonding ceramic veneers. Light-cure luting resins with dual-cure capability may change color as evident from in-vitro observation. The use of light-cure resins without dual-cure capability for bonding veneers is highly recommended.

Article

There has been a transition in the concept of acceptable preparation for porcelain laminate veneers. The authors find this change discouraging as it is not supported by long-term observation and evidence-based dentistry. Dentistry has enjoyed 25 years of success with porcelain laminate veneers first introduced as etched porcelain bonded to enamel restorations. The enamel substrate provides a rigid tooth structure that is compatible with the high moduli porcelain veneer. The light-cured BIS-GMA resin cement is color stable and hydrophobic. The limited amount of water in enamel after etching and drying the minimally prepared tooth allows a successful long-term bonded restoration. Success is further enhanced by proper etching and silanization of porcelain to ensure maximum porcelain-composite bond. It is an ideal match of dental materials and tooth structure with success rates in clinical trials that ranged from 93 to 100% over a period of 15 years and longer.¹⁻⁵ In the 1980s dentists were encouraged by this concept of minimal tooth preparation for veneers in contrast to the aggressive preparation required for a metal ceramic restoration. The overall esthetics of the porcelain veneer was superior to the resin composites available for direct veneer applications. Considering the numbers of in-vitro investigations, controlled clinical studies as well as uncontrolled long-term clinical observation, it is realistic to assume that the concept of etched porcelain bonded to enamel is supported by evidenced-based dentistry.

By the 1990s, the conservative nature of porcelain veneers was adversely affected by the introduction of dentinal adhesives. The absence of any successful longitudinal study of porcelain veneers bonded to dentin did not reduce but encouraged unnecessary and contraindicated use of bonded ceramic veneers. Early strong advocates of veneers bonded to enamel are correctly disturbed and are now cautioning about widespread use of ceramic veneers when other treatment modalities are indicated.⁶⁻⁹ Cases best treated with orthodontics or direct bonding are being treated with ceramic veneers. It is a disservice to the patient to perform these procedures before clinical evidence has demonstrated success with veneers bonded to dentin as it has with veneers bonded to enamel. Reports of 50% failure at six years and 34% fracture is disturbing when compared with 93% to 100% success rate of 15 years observation initiated in the 1980s.⁶ Removal of the facial enamel or selection of teeth without facial enamel for veneer restorations is an attempt to match up high elastic modulus porcelain with lower elastic modulus dentin. It is predictable that functional loading of the veneered tooth will transfer this energy to the interface resulting in debonding or cracking in the porcelain. In the keynote address of the 2005 IADR/ADR on the topic of degradation of resin-dentin bond from above and below, Tay F.R. reported that water permeation adversely affects all dentinal adhesives. Tay found that the newer, simplified no-wash bonding systems failed even more rapidly than did the total-etch and wash systems because of the hydrophilic nature of the no-wash systems.¹⁰ It is safe to assume that scientific information surrounding the new dentinal adhesives does not apply to ceramic veneers bonded entirely to dentin. In consideration of the efficacy of dentinal adhesives, we must keep in mind that most longitudinal clinical studies of dentinal adhesives are performed on non-carious class V lesions where the strength and elastic modulus of the teeth are barely affected.¹¹ Bonding porcelain to dentin differs significantly from bonding direct composite restorations.

Clinical observation suggests that limited superficially exposed dentin surrounded by sound enamel will likely survive the test of time and function. Cervical margins of veneers finished on dentin/cementum appear to offer a much lower success rate. If the facial surface is primarily in dentin, the prediction for success is poor and any attempt to restore teeth with ceramic veneers will likely not succeed. The type of failure and duration of retention of ceramic veneers bonded to dentin depends directly on the type of dentin (sclerotic vs. freshly cut), location of the exposed dentin (CEJ vs. incisal) and the chemistry of dentinal adhesives used.

Longitudinal studies of porcelain veneers fabricated from feldspathic porcelain (stacked porcelain) reveal very few cohesive fractures of the porcelain. In the absence of tooth discoloration, ultra-thin contact lens-like veneers are the treatment of choice.⁵ The desire for veneers with optimal esthetic effects and maximum translucency are best fabricated from stacked and fired porcelain. The high strength porcelains that are either pressed or CAD/CAM will not give the desired esthetic result particularly on non-discolored teeth. High strength porcelain restorations require additional tooth reduction to allow for the additional thickness of the veneer. Plans for porcelain veneers that involve extensive tooth reduction should be avoided. All ceramic crowns or metal ceramic crowns are superior choices when significant dentin is exposed. Full coverage restorations depend less on bonding for retention.

With any type of porcelain veneer, particularly ultra-thin veneers, the color stability of luting resin becomes a critical factor in retaining long-term esthetic results. Ten weeks of accelerated aging of some currently used light-cure with dual-cure capability resins have shown noticeable color change ($\Delta E > 3$).¹²⁻¹⁶ A ΔE of 3 or greater has been shown to be detectable by the human eye. The type of amine required for self-cure materials is typically an aromatic tertiary amine which may readily oxidize to form colored oxidized products. The amines used in light-cure materials are generally more resistant to oxidation and color change. Some clinicians use light-cure restorative resins for bonding ceramic veneers. Although this may increase the film thickness of the resin, it prevents any future color shift. A new generation of 100% light-cure luting resins (Choice 2LC, Bisco, Inc. and Rely X Veneers, 3M ESPE) with ΔE much less than 3 have been introduced. With the popularity of ultra-thin ceramic veneers on the rise, a dire need for color-stable luting resins is obvious.

The role of silane in successful bonding of porcelain is clear. Extensive work by Plueddemann revealed the complexity, yet reliability of silane coupling agents for bonding organic and inorganic substrates.¹⁷ The function of organosilane is to provide bi-functional attachment to both the resin and the porcelain. This has proven to be a very reliable bond. In general the reaction starts when silane coupling agent is mixed with water. The hydrolysis results in formation of silanol that subsequently reacts with the silanol on the surface of the glass.¹⁸ A mixed silane undergoes a condensation process if it is not used shortly after mixing. Although there are methods to extend the shelf life of a pre-mixed silane, the effectiveness of the single bottle system is not validated by literature on silane coupling agent and not shared by these authors. The authors strongly advocate the use of a two-part silane for surface treatment of all etched porcelain.

Conclusion

The primary purpose of selection of porcelain veneers is to provide esthetically pleasing smiles using minimally invasive dentistry. Veneers offer outstanding performance when bonded to enamel. The clinical performance of porcelain veneers bonded to dentin has questionable longevity and will likely result in early failure at the resin-dentin bond. Current clinical observations do not support placement of porcelain veneer margins on dentin. Minimal tooth preparation, ultra thin veneers and color-stable light-cure luting resins provide an excellent service to our patients. Inclusion of scientific rationale and long-term clinical observations to achieve better esthetic results are a must.

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Legend

Figures 1A, 1B, 1C

Three views of debonded ceramic veneers. Debonding occurred at luting resin-dentin interface. Veneers were bonded entirely to dentin.

Figure 2

Frontal view of four maxillary incisors treatment of planned for ceramic veneers. Chief complaint: diastema and short teeth.

Figure 3

Note the minimal preparation performed on #9 before rounding the sharp edges and line angles.

Figures 4A, 4B

Frontal views of ultra-thin veneers bonded with a light-cure luting resin.

Figures 5A, 5B

Right and left views of bonded veneers.