

# Translucent Zirconia Veneers:

## CLINICAL TECHNIQUE AND 4-YEAR FOLLOW-UP

Julian Conejo, DDS, MSc  
Markus Blatz, DMD, PhD



### Abstract

Laminate veneers are a predictable treatment option for patients seeking to improve the esthetics of their smile. With recent advances in adhesive dentistry and restorative materials for the manufacture of indirect restorations, clinicians and laboratory technicians have more options to choose from for this minimally invasive treatment. Understanding the indications, contraindications, and adhesive cementation protocols for each material is paramount to long-term clinical success. This article describes the clinical technique for fabricating translucent zirconia veneers with a 4-year follow-up.

**Key Words:** laminate veneers, occlusal onlays, additive adhesive restorations, intraoral scanning, facial scanning, 3D printing

## Introduction

The main goal of restorative dentists should always be to develop a treatment plan that prioritizes preserving healthy tooth structure while improving the patient's esthetics and function. To this end, indirect partial-coverage restorations such as laminate veneers should be considered before more invasive treatment options are undertaken.<sup>1</sup> Understanding the clinical techniques and working protocols as well as their specific objectives is essential for long-term clinical success. Specific devices in combination with digital technologies and improved materials facilitate quality dental care.<sup>2</sup>

## Materials

### Feldspathic Ceramics or Leucite-Reinforced Glass-Ceramics

Laminate veneers made from feldspathic ceramics or leucite-reinforced glass-ceramics (e.g., VITABLOCS TriLuxe Forte [VITA Zahnfabrik, Bad Säckingen, Germany]; Empress Multi [Ivoclar Vivadent; Amherst, NY]) have been used for decades and provide highly esthetic results. However, the inherent brittleness of these materials requires delicate laboratory and clinical handling.<sup>3</sup> These etchable materials are combined with silane coupling agents to obtain micromechanical and chemical bonds, which are paramount for nonretentive restoration designs such as laminate veneers. Both ceramic materials are available in polychromatic blocks, which facilitate esthetic outcomes when chairside computer-aided design/computer-assisted manufacturing (CAD/CAM) technologies are used.<sup>4</sup>

### Lithium Silicate Ceramics

Lithium silicate ceramics (e.g., IPS e.max CAD [Ivoclar Vivadent]) are also indicated for laminate veneers. Their higher percentage of crystalline phase makes them more resistant to fracture than traditional feldspathic or leucite-reinforced ceramics,<sup>5</sup> but esthetic results are more challenging to achieve due to their lower percentage of glassy matrix and the monochromatic CAD/CAM blocks. When patients seek very bright restorations with a high value, the specific composition and optical properties of these materials may not be ideal, sometimes resulting in a grayish appearance.

### Polycrystalline Metal Oxide-Based Ceramics

**Zirconia:** High-strength polycrystalline metal oxide-based CAD/CAM ceramics, such as zirconium dioxide (zirconia), are characterized by excellent mechanical properties that are significantly greater than those of silica-based ceramics.<sup>6</sup> Flexural strength values of conventional yttria-stabilized tetragonal zirconia polycrystals range between 1000 and 1500 MPa. The inherent strength of these materials allows for conventional cementation of adequately dimensioned full-coverage restorations. The early generations of zirconia had only limited translucency and were therefore used for copings and frameworks that were veneered with a feldspathic veneering porcelain. Their success rates were similar to porcelain-fused-to-metal restorations; however, recent trends favor monolithic ceramic restorations.<sup>7</sup>



GIVEN THE POPULARITY OF ZIRCONIA RESTORATIONS, THEIR CLINICAL APPLICATION AND CEMENTATION PROTOCOLS ARE WIDELY DEBATED. IN GENERAL, THESE RESTORATIONS ARE TYPICALLY CONSIDERED CEMENTABLE BECAUSE OF THEIR HIGHLY INHERENT FLEXURAL STRENGTH, WHICH EXCEEDS NATURAL MASTICATORY FORCES.





**Figure 1:** Preoperative facial view.



**Figure 2:** Preoperative close-up view of patient's smile.



**Figure 3:** Preoperative intraoral view showing diastemas and failing composite restoration.

**High-translucency zirconia:** The latest zirconia generations offer significantly greater light transmission. Preshaded, multilayer, high-translucency zirconia materials in particular offer more esthetic treatment options and can even be applied for anterior restorations. The higher translucency is achieved by slight changes of the yttrium oxide (Y<sub>2</sub>O<sub>3</sub>) content (4 or 5 mol% rather than 3 mol%), which results in a higher amount of cubic phase particles. More cubic zirconia offers significantly higher light transmission but lower flexural strength values than conventional zirconia, between 550 and 800 MPa.<sup>8</sup>

High-translucency zirconia blocks and discs for chairside and laboratory CAD/CAM systems have become extremely popular. Restorations are milled from presintered zirconia with slightly enlarged dimensions to compensate for the 20% to 25% material shrinkage during the final sintering step after milling. With special furnaces (e.g., CEREC SpeedFire [Dentsply Sirona; Charlotte, NC]; Programat CS6, [Ivoclar Vivadent]) and speed-sintering programs, the sintering of a

single restoration can be accomplished within 20 minutes after dry milling.<sup>2</sup>

**Zirconia benefits and drawbacks:** Given the popularity of zirconia restorations, their clinical application and cementation protocols are widely debated. In general, these restorations are typically considered cementable because of their highly inherent flexural strength, which exceeds natural masticatory forces.<sup>9</sup> Therefore, zirconia-based crowns and bridges with adequate retention and ceramic material thickness can be cemented conventionally. Resin-modified glass-ionomer or self-adhesive resin cements are preferred and provide at least a certain level of adhesion to both teeth and ceramics without additional time-consuming and technique-sensitive bonding and priming steps.

**APC Zirconia-Bonding Concept:** However, zirconia restorations that are less strong, thinner, lack retention, or rely on resin bonding, such as resin-bonded fixed prostheses or bonded laminate veneers, require resin bonding with com-

posite resin luting agents.<sup>10</sup> To achieve a long-term durable resin bond strength to zirconia in a practical manner, a three-step approach widely known as the APC Zirconia-Bonding Concept<sup>11</sup> is recommended:

1. (A) airborne-particle abrasion of the bonding surface with aluminum oxide
2. (P) application of special zirconia primer
3. (C) use of dual-curing or self-curing composite resin cement.

After cleaning, the zirconia restoration should be airborne-particle abraded with alumina or silica-coated alumina particles. Small particles (50 to 60  $\mu\text{m}$ ) at a low pressure (< 200 kPa [2 bar]) are sufficient.<sup>11</sup> The subsequent steps include application of a special ceramic primer (e.g., Clearfil Ceramic Primer Plus, Kuraray America; New York, NY) containing special adhesive phosphate monomers. The monomer 10-methacryloyloxydecyl dihydrogen phosphate (MDP) has been shown to be particularly effective for bonding to metal oxides.<sup>12</sup> Dual-curing or self-curing composite resins (e.g., Panavia V5, Kuraray) should then be used to ensure adequate polymerization/conversion. A recent systematic literature review concluded that the bonding protocols considered most successful for conventional 3Y zirconia are also recommended for high-translucency 4Y and 5Y zirconia. The long-term success rates of some resin-bonded zirconia restorations are excellent.<sup>7,13</sup>

## Clinical Case Report

A 28-year-old female patient presented to the authors' clinic with concerns about the esthetic appearance of her anterior teeth. After thorough clinical and photographic evaluation (Figs 1-3) following established digital smile design protocols, a facially driven digital wax-up of the maxillary anterior teeth (#6 through #11) was designed.<sup>14</sup> The presence of extensive diastemas required a detailed mock-up to evaluate the

teeth proportions, alignment, and soft tissue relations after closing the interproximal spaces (Figs 4 & 5).

After 3D-printing a model of the digital wax-up, a silicone matrix was made and relined with light-body polyvinyl siloxane impression material to replicate the details obtained from the natural teeth library selected for the digital wax-up (Fig 6). A bis-acryl material was used for the mock-up, which also served as a preparation guide. After analyzing the mock-up and making minor esthetic modifications, a digital impression was made for the design of the definitive restorations.

## Preparation Technique

The laminate veneers were prepared according to a CAD/CAM preparation system developed by the authors (Brasseler USA; Savannah, GA) (Fig 7).

- A 0.3-mm depth cutting bur was used on the facial aspect. It is important to maintain this measure of reduction, especially on the cervical third, as enamel is thinner in that area (Fig 8).
- A fine-grit diamond bur was used for facial reduction following the cervical, middle, and incisal planes on the mock-up. This technique creates the restorative spaces needed for the ceramic while conserving more enamel in areas where an additive restoration is intended.
- The preparation of the interproximal surfaces depends on the presence and dimensions of the diastemas. When a proximal contact exists and the new smile design does not require shifting the teeth mesiodistally, there is no need to open the contact. For moderate diastemas (less than 1.0 mm), a facial margin is prepared without involving the entire proximal surface. When extensive diastemas are present, the preparation should be extended interproximally to facilitate creation of a proper emergence profile, avoiding black triangles or overcontoured areas that may cause food impaction (Fig 9).



THE DEVELOPMENT OF MORE TRANSLUCENT, MULTILAYERED TYPES OF ZIRCONIA MATERIALS HAS FACILITATED EXCELLENT ESTHETIC RESULTS WHILE PROVIDING HIGH FLEXURAL STRENGTH AND BIOLOGIC PROPERTIES CONDUCTIVE FOR SOFT TISSUE INTEGRATION.





**Figure 4:** Additive digital wax-up of maxillary anterior teeth at 50% translucency to evaluate the space distribution.



**Figure 5:** Final digital wax-up of maxillary anterior teeth.



**Figure 6:** 3D-printed model with relined silicone matrix.



**Figure 7:** Burs for preparation of laminate veneers.



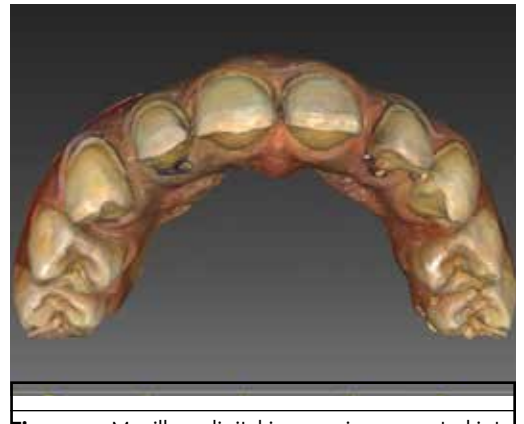
**Figure 8:** Depth cuts on facial and incisal surfaces as reduction guides.



A DETAILED TREATMENT PLAN, CAREFUL CLINICAL EXECUTION, AND PROPER BONDING TECHNIQUE ARE THE FOUNDATION FOR THE LONG-TERM CLINICAL SUCCESS OF LAMINATE VENEERS INDEPENDENT OF THE CERAMIC MATERIAL SELECTED.



**Figure 9:** Final preparations showing smooth transitions and enamel preservation.



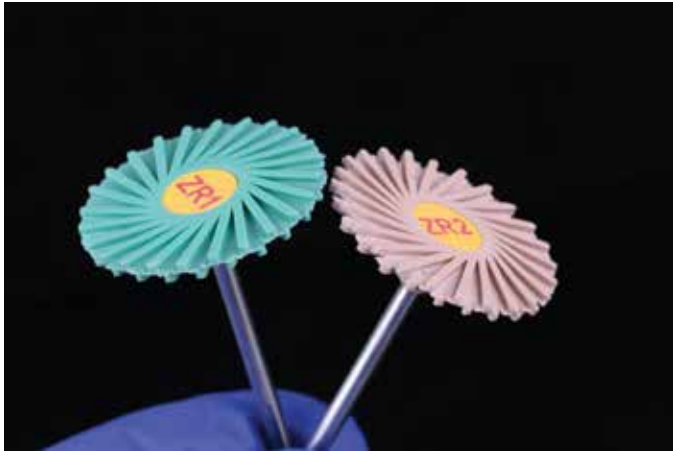
**Figure 10:** Maxillary digital impression exported into the laboratory software.



**Figure 11:** Facial surface of ultra-translucent zirconia veneer after staining and glazing.



**Figure 12:** Proximal surface of ultra-translucent zirconia veneer with ideal marginal stability at reduced thickness (0.3 mm).



**Figure 13:** Diamond-impregnated feathered wheels adapt to all surfaces of the restorations.



**Figure 14:** Clear try-in paste to stabilize the laminate veneers and evaluate the final color.

## Tips

» When prepping for laminate veneers, use a 0.3-mm depth cutting bur over the mock-up to ensure that no unnecessary enamel is being removed. This will provide a higher bond strength to the tooth surface.

» When trying in zirconia veneers, mark the areas in direct contact with the tissue and polish them manually. This will enhance soft tissue adherence and promote gingival health and stability.

» After try-in, always clean the restorations in an ultrasonic bath with alcohol followed by air abrasion with alumina particles. This will provide a clean zirconia surface to apply the primer and resin cement for stronger bonding to the restoration.



**Figure 15:** Intaglio surfaces of the zirconia laminate veneers were airborne-particle abraded (APC technique, step A).



**Figure 16:** The MDP-containing ceramic primer was applied with a micro brush (APC technique, step P).



**Figure 17:** Clear resin cement was applied directly to the veneer with a mixing tip (APC technique, step C).

- After placement of an epinephrine-impregnated single retraction cord (Ultrapak #000, Ultradent; South Jordan, UT), a chamfer finish line was prepared at tissue level, and an ultra-fine diamond bur was used to smooth out any sharp line angles in the preparation. All preparation steps were made at 100,000 rpm with an electric handpiece under high magnification.<sup>15</sup> A continuous second retraction cord was placed (Ultrapak #00) and removed immediately before making the digital impression (CEREC Omnicam). It is important to review the digital impression and to ensure that all areas of the abutment teeth and adjacent soft tissues have been properly scanned and that all margins are visible. Last, digital impressions of the maxillary teeth and interocclusal records were made and exported as STL files to the dental laboratory (Master's Arch; Phoenix, AZ) (Fig 10).

After reviewing and approving the design proposal with the dental technician online, the restorations were milled from a highly translucent multicolor zirconia material (Katana UTML, Kuraray) (Figs 11 & 12). External stains and a fluorescent glaze were applied (CERABIEN ZR, Kuraray). The portions of the zir-



**Figure 18:** Postoperative intraoral view of ultra-translucent zirconia veneers at 4-year follow-up.

conia veneers that were in direct contact with the soft tissues were manually polished in two steps (Dialite ZR, Brasseler) at 8,000 rpm, as a polished subgingival surface improves soft tissue adaptation to the zirconia restoration (Fig 13).<sup>16</sup>

Following removal of the provisional restorations, a clear try-in paste (Panavia V5) was used to stabilize the restorations and evaluate their esthetics. After the try-in paste was removed with an air-water syringe, the restorations were placed in an ultrasonic bath with alcohol for 5 minutes (Fig 14). After air-drying, the veneers were airborne-particle abraded with 50- $\mu$ m alumina particles at a low pressure (< 200 kPa [2 bar]) (Fig 15). The subsequent steps included application of an MDP ceramic primer (Clearfil Ceramic Primer Plus) (Fig 16) and the use of a dual-curing composite resin cement with an amine-free catalyst to ensure adequate polymerization and stable long-term esthetics (Panavia V5) (Fig 17). After tack-curing the cement for 3 seconds, the excess was removed with micro brushes and dental floss before full polymerization. Any polymerized residual cement was removed with a scalpel blade and interproximal finishing sandpaper strips.



**Figure 19:** Postoperative intraoral view showing soft tissue adaptation to polished zirconia surface and reestablished papillae.

## Summary

Continued advances in adhesive dentistry provide reliable protocols not only for bonding glass-ceramic materials to laminate veneers but also for the bonding of monolithic zirconia. The development of more translucent, multilayered types of zirconia materials has facilitated excellent esthetic results while providing high flexural strength and biologic properties conducive for soft tissue integration (Figs 18-23). Consequently, translucent zirconia veneers have become a viable treatment option, especially in situations where a high value is desired. A detailed treatment plan, careful clinical execution, and proper bonding technique are the foundation for the long-term clinical success of laminate veneers independent of the ceramic material selected.



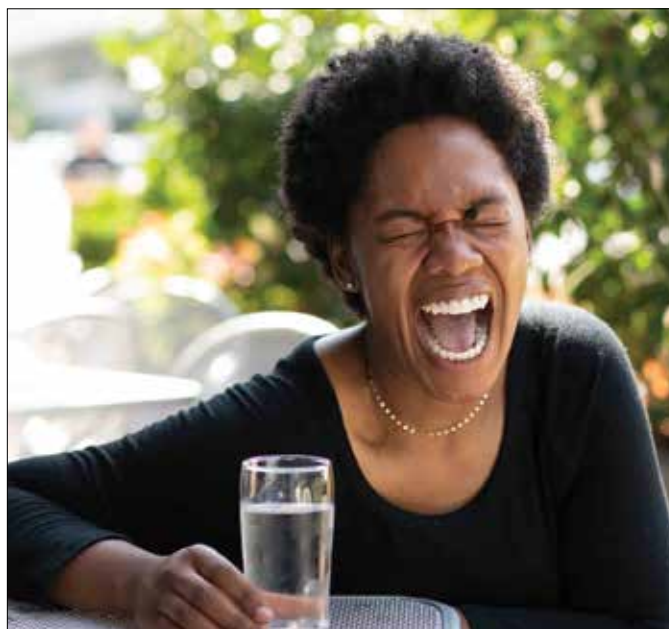
**Figure 20:** Postoperative close-up smile view.



**Figure 21:** Postoperative frontal view.



**Figure 22a & 22b:** Postoperative lateral views at the 4-year follow-up.



**Figure 23:** Joyful patient at the 4-year follow-up.

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Dr. Conejo is an assistant professor of clinical restorative dentistry and director of chairside CAD/CAM dentistry in the Department of Preventive and Restorative Sciences at the University of Pennsylvania School of Dental Medicine in Philadelphia.



Dr. Blatz is a professor of restorative dentistry, chair of the Department of Preventive and Restorative Sciences, and assistant dean of digital innovation and professional development at the University of Pennsylvania School of Dental Medicine in Philadelphia.

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