RESTORATION OF THE ANTERIOR MAXILLA WITH ULTRACONSERVATIVE VENEERS: CLINICAL AND LABORATORY CONSIDERATIONS

Jeffrey Rouse, DDS*  
Steven McGowan, CDT†

One significant challenge in aesthetic dentistry is to integrate individual restorations with the adjacent natural dentition. In order to achieve a seamless result postoperatively, the clinical preparation and the laboratory fabrication phases of treatment must be performed in concert. The use of ultraconservative laminate veneers is a restorative modality that permits the development of a functional, aesthetic outcome while preserving the greatest degree of natural tooth structure. This article highlights the preparation design and material considerations that are involved with ultrathin porcelain laminate veneer restorations.

Key Words: veneer, preparation, ultrathin, color, bonding

Due to their lifelike appearance and long-term dependability, porcelain laminate veneers are often selected for the aesthetic restoration of the anterior dentition. In order to maximize aesthetics, improve fracture resistance, optimize laboratory artistry, and maintain soft tissue health, tooth preparation is generally required for these restorations. The standard facial enamel reduction (0.5 mm to 0.7 mm) for a veneer provides the laboratory technician ample space to stack, fire, and finish the laminate without fracturing it. This reduction can also facilitate space for porcelain layering techniques while avoiding the fabrication of restorations with an opaquous, monochromatic, or bulky appearance. An increase in preparation depth allows for improved color masking as well.

While increased preparation depth allows for improved color masking, it is not always necessary and may even be counterproductive. If the tooth shade is correct, a thicker porcelain veneer can compromise the natural value and chroma, which results in a restoration with an artificial appearance (Figure 1). In addition, while the success of enamel-bonded veneers cannot be disputed, bonding a veneer to dentin is less predictable. Unfortunately, a traditional veneer preparation can yield a significant degree of dentin exposure, particularly in the cervical one third. The mean thickness of enamel at the gingival third is 0.4 mm on maxillary central incisors and only 0.3 mm on maxillary lateral incisors. A gingival reduction of 0.5 mm could therefore expose a significant amount of dentin and make the veneers more susceptible to microleakage, pulpal irritation, recurrent caries, fracture, and debonding. Despite the use of dentin bonding agents, research shows no significant decrease in microleakage of porcelain veneers cemented on dentin margins.

*Director, Fellowship in Aesthetic Dentistry, University of Texas Health Science Center, San Antonio, Texas; private practice, San Antonio, Texas.
†Dental technician, Arcus Laboratory, Seattle, Washington.

Jeffrey Rouse, DDS  
2803 Mossrock, Ste. 201  
San Antonio, TX 78230  
Tel: 210-341-4409  
Fax: 210-341-4483  
E-mail: TXAcademy@oal.com

Figure 1. Facial view of thick porcelain veneers on preparations with normal color. Note the opaque, monochromatic appearance of the veneer restorations.
Ultraconservative preparation techniques require cervical reduction of 0.3 mm and midfacial reduction of 0.3 mm to 0.5 mm. This process is designed to enhance the translucency of a veneer. A minimal reduction of tooth structure allows the translucency of the veneer — rather than the porcelain — to render a natural appearance. Furthermore, by preserving the dentinoenamel junction, the ultraconservative preparation increases the available enamel for bonding, thus decreasing the risk of veneer failure.

**Ultraconservative Preparation Design**

The ultraconservative preparation is initiated with an incisal edge reduction of 1.5 mm to 2.0 mm from the final incisal edge position. For example, if 1.0 mm will be added to the incisal edge, then a reduction of only 0.5 mm to 1.0 mm is required to provide the laboratory technician with sufficient space for the creation of translucency and an incisal halo for the veneer. The finish line on the lingual aspect of the restoration is a butt joint and should not end on a wear facet (Figure 2). Although an enamel-bonded veneer finished with a lingual butt joint has the same fracture resistance as a natural tooth, a lingual chamfer finish line appears to increase its susceptibility to fracture. Horizontal depth grooves can be used to gauge proper buccal reduction and prevent over-preparation of the enamel. In order to ensure a proper reduction, a bur with a single 0.3 mm depth gauge is used to mark proper cervical and facial reduction (Figure 3). When a three-diamond cutter crosses the tooth mesiodistally, the labial convexity of the surface produces uneven enamel reduction. Final preparation to the depth of the grooves is completed with a medium-grit, rounded-end cylindrical diamond (KS-O, Brasseler USA, Savannah, GA). The depth of reduction into the contact varies with each patient. While the preparation can be stopped facial to the interproximal contact or extended through the contact to the lingual surface, it should not be finished in the interproximal contact area. Generally, increasing the interproximal reduction allows the laboratory technician greater freedom in the alteration of tooth form and position (Figure 4).

**Laboratory Considerations**

Ultra-thin veneers have become possible and popular due to improvements in clinical and laboratory techniques and the development of natural illuminating porcelains. The optical properties of new generation, "renaissance" porcelains more closely mimic the interaction of the
Transmission of new ceramic. In transmitted light, its natural illumination allows transmission of long wavelengths (i.e., red, yellow) of light.

Figure 5A. Opalescence of traditional porcelain. 5B. Opalescence of new ceramic. In transmitted light, its natural illumination allows transmission of long wavelengths (i.e., red, yellow) of light.

Figure 6A. Opalescence of traditional porcelain. 6B. Opalescence of new ceramic material. In reflected light, its natural illumination reflects short wavelengths (i.e., blue, violet) to impart a blue appearance.

natural dentition with light. The "illusion of reality" is developed by carefully blending opalescence, fluorescence, and translucency.

Opalescence is a general term that applies to the phenomenon whereby an intense scattering of visible light is facilitated by a body with strong optical inhomogeneities. The opalescent properties of enamel increase the value of the underlying dentin. Prior attempts to fabricate ultrathin veneers reduced the value of the restoration and resulted in a graying effect due to the use of older nonopalescent enamel porcelains with two-dimensional color that did not manipulate light. Contemporary ceramic systems are composed of opalescent enamel porcelains that distribute light in a more natural manner and change depending on the light source (Figures 5 and 6). These materials eliminate the graying effect and maintain the high value of the restoration. The opalescent effect becomes more critical in veneer restorations with reduced thickness.

Fluorescence, which is defined as the ability of a substance to absorb light of a narrow spectrum and instantaneously emit light in another spectrum, has also received increased emphasis in porcelain and composite technology (Figure 7). Natural teeth fluoresce blue when exposed to ultraviolet light below the visible spectrum. Dental manufacturers, in order to mimic natural tooth luminescence, began in the 1970s to add inorganic oxides (including uranium) to base porcelain. Due to health concerns, the material was changed to alternate rare earth ions whose primary excitation wave is 330 nm and emission peak is 420 nm, which corresponds to the blue emission wavelength of the natural dentition. Since fluorescent porcelains reflect more light than standard opaque porcelains, the former are preferable as masking agents in ultrathin veneer restorations.

Although the terms are often used interchangeably, translucency is different from transparency. All the light that strikes a transparent material is transmitted. Small particles inside translucent porcelains, however, scatter light in all directions. Transparent porcelain is often utilized at the margins of porcelain inlay, onlay, and veneer restorations. In theory, this "contact lens" effect allows complete transmission of light to the underlying preparation and establishes undetectable margins. While this effect can provide adequate results for the occlusal margins of inlay and onlay restorations, experience has indicated that transparent margins on veneers instill a gray, dead look in the gingival one third. In the intraoral environment, composite luting cement of any thickness has

Figure 7. Fluorescent ceramic materials can achieve emission peaks (420 nm) similar to the natural dentition.
a tendency to absorb water, which can cause the restoration to appear gray. Therefore, a veneer that appears aesthetic at insertion may exhibit dull, dead margins over extended function. The placement of colored translucent—rather than transparent—porcelains at the margins, can reflect light and mask the dulling of the marginal composite material.

**Ceramic Buildup**

Several difficulties (eg, fabrication, risk of fracture, overcontouring the veneers) have previously been encountered with the use of ultraconservative preparations. The evolution of sophisticated fabrication techniques and contemporary porcelain materials, however, has allowed these concerns to be addressed. Today, the masking of the junction between the preparation and unsupported porcelain, the control of value, and the color blockout are primary challenges of the laboratory phase.

Laboratory fabrication of the incisal 2 mm of the ultraconservative veneer, traditional veneer, metal-ceramic, or all-ceramic crown restoration is very similar. The ultraconservative veneer, however, requires a fundamental alteration in laboratory porcelain concepts. A distinction between these restorations is the transition point between the incisal ceramic material and the tooth preparation. Clinicians often indicate that this point of transition can be observed, particularly in patients with fractured teeth. The junction of the incisal and body materials cannot be detected in full-coverage crown restorations due to the thickness of porcelain. In an ultrathin veneer, however, it is not possible to conceal the junction with a bulk of porcelain. The key in masking the transition is through the application of a highly reflective modifier (Flu-Dentin, Duceram Plus, Degussa, South Plainfield, NJ), which has the same relative opacity and fluorescence as natural dentin. Consequently, it will provide a highly reflective band that conceals the junction and allows an invisible transition to be achieved.

The ceramic buildup technique on the body of an ultrathin veneer varies significantly from other porcelain restorations (eg, traditional veneers). In order to match chroma and control value, the ultraconservative veneer is designed with "reverse translucency." In traditional veneers, color and value are controlled by masking or opaquing the underlying colors of the tooth and allowing the veneer to become more translucent in the incisal third only. Using reverse translucency, however, the most
opaque portion of the restoration is the incisal third and the most translucent section is the body (Figure 8). Therefore, these veneers have minimal dentin porcelain in the body, which allows the tooth rather than the ceramic material to dictate color. Yet, this concept cannot be applied to all types of veneer restorations. The fabrication of a veneer with a thickness of 0.5 mm to 0.7 mm and reverse translucency would significantly reduce the value of the laminate restoration (Figure 9). In the absence of an opaque base, light striking the restoration will be absorbed by the ceramic material. Therefore, thicker porcelain absorbs more light and causes a greater shift in value. If the veneer is ultrathin and the porcelain is highly opalescent, however, light will be reflected naturally and maintain the high value.

With an ultrathin veneer restoration, color blockout can be difficult to achieve. The color of the tooth preparation will be used for the development of natural color. It is important, therefore, that clinicians provide the laboratory with a photograph of the final preparation. With this photograph, the tooth can be measured by the technician to locate maverick colors or discolorations that will be concealed (Figure 10). Failure to communicate this information prevents the masking of maverick colors; opaques porcelain will, by necessity, be added indiscriminately to conceal blemishes and reduce the translucency of the veneer. Once the blemishes have been identified, masking agents can be selectively added to the restoration. Color-modifier porcelains (feldspathic porcelains with added color pigments) are routinely used to create optical effects and conceal discolorations in restorations. At a depth of 0.3 mm, the color of the porcelain and the modifiers is less significant. As translucent materials become thinner, the color pigments have less of an impact on the overall color. Therefore, color characteristic stains are utilized to achieve similar effects in ultrathin veneers. These stains are opaque metal oxides that are painted into wet porcelains. The stains are placed into cuts to simulate cracks and craze lines or painted over areas to mask or further characterize the tooth and subsequently covered with a thin layer of opalescent porcelain prior to firing (Figure 11).

These layering techniques can also be utilized to satisfy the expectations of patients who present for aesthetic enhancement. In general, when the underlying tooth is the correct hue, it is possible to modify the tooth by one shade for every 0.2 mm of tooth reduction. In fact,
at a depth of 0.3 mm, the chroma of the porcelain is almost insignificant; it is the brightness that is critical. Consequently, ultraconservative veneers can provide an efficacious means of matching existing tooth color or performing minor color alteration.

**Case Presentations**

**Case 1**

A 28-year-old female patient presented with a fracture of both maxillary central incisors (Figure 12). The teeth had been damaged by trauma 7 years previously and the teeth remained vital. The incisal edges had been repaired with composite resin that would either stain or fracture after a brief period of service. Due to previous difficulties with direct bonding, this restorative option was rejected by the patient, who requested aesthetic treatment. Since enamel-bonded veneers are more reliable than dentin-bonded crown restorations, the decision was made to restore the maxillary central incisors with porcelain laminate veneers. In this instance, 3 mm of unsupported porcelain would remain following treatment. Although research indicates that 2 mm of unsupported porcelain does not increase the risk of subsequent fracture, 3 mm appears to be acceptable in patients with minimal parafunction. The patient gave consent to the treatment plan, which was then implemented.

Since the original line angles of the teeth still existed, re-creating the shape of the missing segments was not difficult; the challenge was to match the high value and low chroma of the natural dentition and to conceal the fracture demarcation in the veneer restoration. In order to mask the junction between supported and unsupported porcelain, the preparation design was modified. An ultraconservative reduction was chosen for the bulk of the preparation to ensure an adequate enamel bond and easier color match. If the 0.3 mm preparation had been extended to the fracture, it would not have provided the technician with sufficient space to incrementally build up fluorescent porcelains. Since the definitive restoration would display the fracture line, the preparation was tapered midfacially into the fracture (Figure 13). The incisal aspect was reduced 1.5 mm and finished lingually with a butt-joint margin. This preparation design allowed the laboratory technician to match the chroma and value of the natural dentition and taper the porcelain into the fracture to reestablish the missing segment. The veneers were subsequently bonded with a light-cured adhesive and composite resin (Figure 14). The postoperative results achieved the aesthetic expectations of the patient.

**Case 2**

A 53-year-old female patient presented with discolored composite resin that had been placed to close a diastema between the maxillary central incisors (Figure 15). The patient was dissatisfied with the aesthetics of the existing restorations and requested treatment with porcelain laminate veneers. Measurements of the teeth confirmed that the space could be closed without creating an unnatural length-to-width ratio. Since the shade of the adjacent teeth was within one shade of the desired final result, an ultraconservative veneer was selected as the restorative modality.

![Postoperative facial view of 0.3 mm ceramic veneers. Note that the low chroma of the natural teeth was duplicated in the restorations without lowering the value.](image1)

![Preoperative facial view of diastema closure. Note compromised aesthetics of the dentition and gingival tissue.](image2)
In order to perform aesthetic closure of the diastema, it was critical to adjust the interproximal contours and embrasures and to reshape the interdental papilla in the laboratory phase. While the depth of the preparation remained 0.3 mm, the interproximal preparation extended to the linguoproximal line angle and 1.0 mm subgingivally. This ultraconservative design allowed the laboratory technician to overcontour the restoration proximally, which altered the tissue contour while maintaining the proper visual face of the teeth by controlling heights of contour (Figure 16). In addition, the matching of the chroma and value was simplified by allowing the natural underlying tooth color to dictate the chroma and value through the ultrathin veneer restoration (Figure 17). Light-cured adhesive material and composite resin were utilized to bond the veneer restorations. As a result of the prosthetic manipulation of the gingival tissues, the treatment was able to enhance the aesthetic appearance of the definitive restorations and the gingival architecture.

Conclusion
The use of ultraconservative preparation techniques and veneers allows the restorative team to effectively match the natural dentition and achieve the increasing aesthetic demands of their patients. In addition, the conservative gingival reduction ensures the development of an improved enamel bond that could potentially reduce microleakage, staining, and debonding.

This article has also provided a discussion of contemporary or “new generation” porcelain materials that are characterized by physical and optical properties (eg, opalescence, fluorescence, translucency) that more closely resemble those of the natural dentition. Utilized in combination with advanced stratification and preparation techniques, these characteristics allow the development of ultrathin veneers that mimic natural contour and color while masking the incisal-tooth interface.

References