Ultimate Ceramic Veneers: A Laboratory-Guided Preparation Technique for Minimally Invasive Restorations

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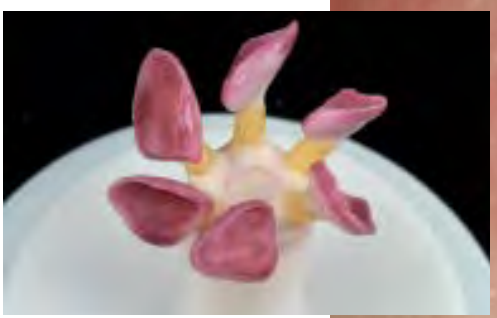
Ceramic laminate veneers are a predictable treatment option for esthetic anterior restorations. When bonded to enamel, ceramic veneers offer stable long-term results. By using current laboratory techniques associated with a strict clinical protocol, very thin veneers can be provided with minimal loss of hard tissue. This article presents a novel treatment technique—the ultimate ceramic veneer—in which tooth preparation is laboratory guided and performed after final impression taking. Based on the wax-up and mock-up, the ceramist prepares the die only where there is no space for the ceramic. Thus, the final result is based on a conservative approach that creates minimally invasive restorations. *Am J Esthet Dent 2013; 3:8–22. doi: 10.11607/ajed.0054*



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The current trend in restorative dentistry is preservation of the tooth structures associated with adhesive restorations.[1] For anterior dentition, treatment modalities such as direct composite resin restorations have proven to be clinically effective.[2] When used for small cavities and add-on procedures in young patients, composite resin allows for minimally invasive esthetic results. Other advantages include low costs and repairability in cases of chipping or color change.[3] Further, when indicated, composite resin can be used in conjunction with direct or indirect techniques.[1,4] However, there is still a lack of scientific evidence regarding the long-term clinical performance of composite resin restorations in the anterior dentition.

Another option for the treatment of anterior dentition is ceramic laminate veneers. Studies have shown that ceramic veneers show wear patterns similar to those of enamel, low plaque adherence,[5] and excellent dimensional stability.[6] Due to its color and optical properties, ceramic represents the material of choice when a high level of esthetics is required.[7] However, this material must be bonded to the tooth structure, and the success of bonding is dependent on surface treatment of the tooth and ceramic. Laminate veneers do not offer any mechanical retention; thus, the use of adhesive luting systems is recommended. The bond of the luting cement to the tooth structure can be enhanced by acid etching of the enamel or dentin and by the use of a dentin adhesive system. The penetration of monomers into the demineralized dentinal matrix and/or etched enamel, followed by polymerization, promotes the micromechanical bond via hybrid layer formation. Similarly, the internal surface of the ceramic restoration must be prepared to optimize the micromechanical bond between the ceramic and resin. Silicate-based ceramics are the only type that can be used as laminate veneers or ultraconservative restorations. These ceramics can also be silanized to improve their bond strength and longevity. Laminate veneers have been used for more than two decades and were the original minimally invasive concept for indirect restorations.[8,9]

Initially, laminate veneers were used in conjunction with minimal or even no tooth reduction. At that time, the refractory die and platinum foil techniques were the most commonly used fabrication methods. However, clinicians and ceramists faced problems regarding the handling of such restorations. Glass-ceramic veneers showed very low fracture resistance before bonding. In addition, to achieve the best optical and mechanical properties, the build-up procedure had to be carefully controlled to avoid air bubbles.[10] For these reasons, the use of powder-and-liquid glass-ceramic was time consuming and required extremely precise techniques. To overcome those problems, reinforced materials were developed.

In the early 1990s, pressed glass-ceramic was developed based on the lost-wax technique.[11] By increasing the crystal (leucite) content, this material allowed for the fabrication of laminate veneers with improved mechanical properties, thus reducing the disadvantages described above. However, the first generation of pressed ceramics demanded more space for the restoration compared with powder-and-liquid systems. In addition, the esthetic characteristics were obtained using tints and paint, creating restorations that did not have the same quality in terms of vivacity and esthetics. Nonetheless, laminate veneers fabricated using pressed glass-ceramic gained popularity.[12]

Recently, a new generation of glass-ceramic with improved material properties—lithium disilicate glass-ceramic—has allowed technicians to create very thin ceramic restorations. Initially, this material showed high levels of opacity, thus limiting its application for minimally invasive veneers.[13] Today, the newest generation of lithium disilicate materials (IPS e.max Press/IPS e.max CAD, Ivoclar Vivadent) offers multiple translucencies and opacities as well as the capacity for surface staining and glazing. This material has roughly five times the resistance of traditional feldspathic porcelain. Extremely low fracture rates are the greatest advantage of this generation of lithium disilicate materials.[14] These materials are suitable for the fabrication of laminate veneers with minimal preparation.

Thus, recent advances in material science have allowed the field of restorative dentistry to refocus on minimally invasive procedures.[15] The concept of maximum enamel preservation in conjunction with the possibility of creating thin veneers with better optical and physical properties has provided new approaches for esthetic dental treatment.[16,17]

This article presents an esthetic rehabilitation using the ultimate ceramic veneer (UCV) technique.[17,18] This technique is based on laboratory-guided fabrication after final impression taking. No preparation is carried out before receiving a customized laboratory preparation guide. Using this guide, the clinician reduces only those areas necessary to create space for the ceramic. The UCV technique is a conservative and innovative procedure for maximum enamel preservation.

Figs 1a to 1g Preoperative views showing the diastemata from canine to canine and lack of symmetry on both sides.

CASE REPORT

This case involved the esthetic anterior maxillary rehabilitation of a young woman using the UCV technique. The patient's chief complaint was the presence of diastemata and an esthetically unpleasant smile (Fig 1). After all

treatment options were explained and discussed with the patient, it was decided to restore the maxillary incisors and canines using ceramic laminate veneers.

Diagnosis and Treatment Planning

The pretreatment examination included careful analysis of the occlusion and periodontal evaluation. Radiographs and a complete set of facial and intraoral photographs were taken. Special attention was paid to the canine guidance. The canines are important not only in the esthetics of the smile but also in the maintenance of adequate occlusion. Frontal facial photographs were used to help the dental technician determine the correct facial midline. Lateral smile views and the facebow determined the inclination of the maxillary smile line. For the wax-up procedure, the dies were placed in position on a semi-adjustable articulator.

Additive Preliminary Wax-up and Mock-up

When the treatment plan calls for a minimally invasive approach, the wax-up must be fabricated using a careful additive technique. The wax-up must take into consideration the desired tooth characteristics, smile appearance, and pattern of occlusion as well as the patient's age, personality, and gingival biotype.

Another important issue to address in cases with minimal or no preparation is the lack of provisionalization. Thus, the patient must approve the final esthetic design during the mock-up session, which means the initial wax-up serves as the blueprint for the final restoration. For this reason, the quality of the dies is very important. The impression material must allow for multiple pours with high accuracy (eg, vinyl polysiloxane [VPS] impression material).

The preliminary wax-up was transferred to the mouth for clinical evaluation. A mock-up was performed using bis-acrylic resin (Protemp 4, 3M ESPE). Careful evaluation was conducted to check the wax-up in terms of shape, size, length, and smile design (Figs 2a and 2b). Any alterations desired by the patient or clinician must be analyzed and adjusted if necessary. After patient approval, all information was collected by the mock-up using digital photography and an alginate impression to obtain a die of the simulation. The mock-up was then removed from the mouth, and the teeth were pumiced for impression taking. The mock-up is also useful because it can be measured to check the thickness of the bis-acrylic resin and thus predict the amount of preparation needed for the final restorations (Figs 2c and 2d).

Impression Procedures

A VPS (Virtual, Ivoclar Vivadent) one-step double-mix impression technique was used. Thin retraction cord (Ultrapack no. 00, Ultradent) was placed in the sulcus for better visualization of the cervical region and thus better control of the future restoration. Two impressions of each arch were taken.

Figs 2a and 2b Extraoral views with the mock-up in place.

Figs 2c and 2d Evaluation of the thickness of the mock-up.

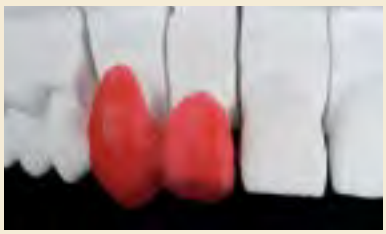



Fig 3a *(left)* UCV preparation guide for the right canine and lateral incisor on the sectioned cast.

Fig 3b *(right)* UCV preparation guide for the left canine.



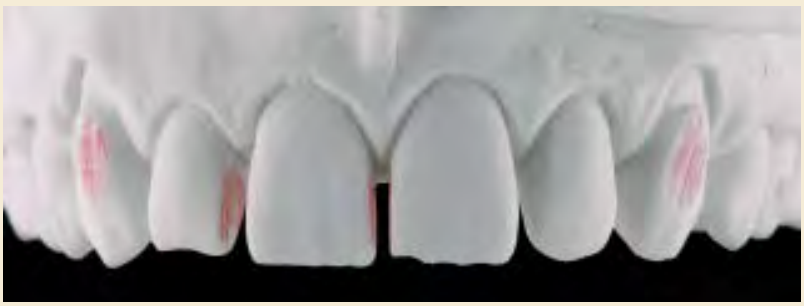



Figs 3c to 3h Complete UCV preparation guide in position.

Laboratory Procedures

After all information was obtained by the mock-up, the molds were poured and remounted on the articulator. Based on the wax-up, the ceramist checked the space available for the veneers. For this treatment modality, the first step must be to define the path of insertion.[1] In this case, a proximal preparation was required because of the presence of diastemata. Only the retentive area of the tooth was altered on the cast.

As planned, no preparation was performed prior to impression taking. Thus, before preparing the cast, the ceramist created the UCV preparation guide with pattern acrylic resin (GC Pattern Resin, GC America). In the areas requiring preparation, the preparation was carried out through the acrylic resin guide until reaching the stone (Figs 3 and 4). After reduction, the guide was removed and the clearance checked using the previous silicone guide made from the wax-up. If more room was necessary or if the path of insertion did not allow for placement of a restoration, the guide was repositioned and more stone was removed. The UCV preparation guide used on the die would be the same one used for intraoral tooth reduction. Both the interproximal tooth areas and the facial ridges of the canines were reduced.



Figs 4a and 4b Areas requiring preparation were marked on the cast.

Fig 5a Waxed dies in position to be placed in the investment cylinder.

Fig 5b Wax-up of the final restorations.

Fig 5c Ceramic restorations on the master cast.

Clearance for the ceramic restoration was checked with the silicone guide. On the modified die, the wax-up of the final restoration was built up, and six laminate veneers were injected with high translucency lithium disilicate glass-ceramic ingot (IPS e.max Press) (Figs 5a and 5b). In this case, it was possible to add a layer of compatible glass-ceramic (IPS e.max Ceram, Ivoclar Vivadent) to provide better esthetics via anatomical intrinsic modifications. Morphologic and surface corrections as well as evaluation of the

marginal adaptation were performed, and the veneers were carefully adjusted on the master dies.

The restorations were then stabilized for occlusal adjustment and confirmation of anterior guidance. The final anatomy and morphology were determined at this time.

Next, stains were applied to provide lifelike characteristics, and the veneers were baked to stabilize these additions. The thin veneers were checked again on the intact master cast (Fig 5c) and sent to the clinician.

Tooth Preparation

At this stage, the clinician received the following items from the laboratory: the intact master die, sectioned die, set of UCV preparation guides, and final restorations.

The UCV guide was positioned and carefully checked for proper stability (Figs 6a to 6e). It is extremely important that the guide remains stable. A thin tapered diamond bur was used to reduce the labial crest of the canines and interproximal areas, as done in the laboratory phase by the ceramist (Figs 6f to 6i). Finishing procedures were carried out using contouring and polishing disks (Soflex, 3M ESPE) to smooth the enamel surfaces. Figure 7 shows the final tooth preparation; note how conservative the reduction was when compared to the initial situation (see Figs 1d to 1g).

After preparation, each laminate veneer was tried in. The remaining procedures were the same as those for any indirect restoration: evaluation of the marginal adaptation, interproximal contacts, anatomy, shade, and overall esthetics of the new smile design.

Try-in and Bonding

As previously mentioned, no provisional restorations were used. The soft tissues remained stable. The final shade of the laminate veneers will be affected by the color of the resin cement; therefore, final bonding was preceded by a try-in procedure to select the resin cement. Try-in paste was applied and evaluated by the patient and clinician. On the right central incisor, the –3 low-value try-in paste (Variolink Veneer, Ivoclar Vivadent) showed a clear difference when compared to the +3 high-value paste (Fig 8). The latter resin cement was selected. Typically, resin cement with a high value is preferable.

The veneers were etched and bonded one by one. The intaglio surface was etched with hydrofluoric acid (9%) for 20 seconds. After washing for 30 seconds, the veneers were placed in an ultrasonic cleaner with distilled water for 5 minutes to remove any acid or residue. A silane-coupling agent was applied and left undisturbed for 2 minutes; the evaporation of the solvent was completed with a constant airflow. The intaglio surface was coated with hydrophobic bonding agent (Heliobond, Ivoclar Vivadent) and thinned by a gentle flow of oil-free air. The adhesive was left uncured, and the restoration was protected with a plastic cover to avoid premature adhesive polymerization.

For better moisture control, rubber dam was placed (Fig 9a). The enamel was pumiced, followed by air abrasion

Figs 6a to 6e UCV preparation guide in the patient's mouth prior to enamel reduction.

Figs 6f to 6h Slight tooth reduction through the UCV preparation guide.

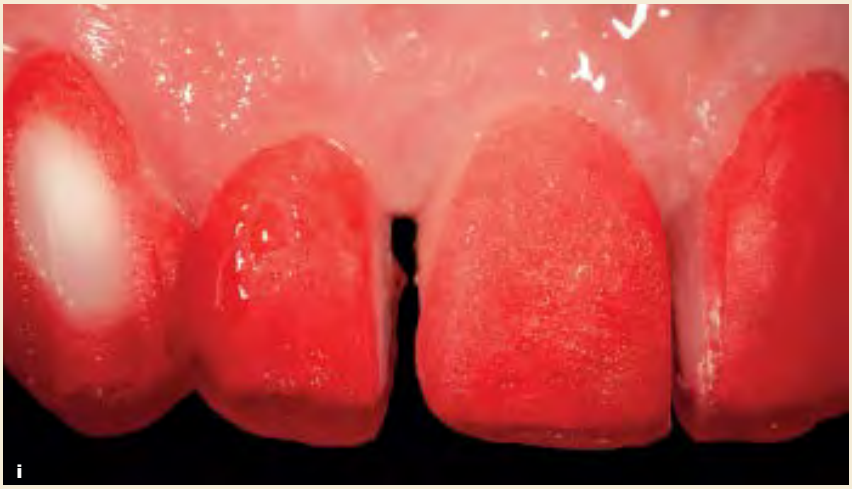


Fig 6i Buccal view after interproximal preparation of the right central and lateral incisors.

(PrepStart H2O, Danville) with 50-µm aluminum oxide particles at 40 psi (Figs 9b and 9c). The surface of each tooth was etched with 37% phosphoric acid (Ultraetch, Ultradent) for 60 seconds, washed, and dried (Figs 9d to 9f). The same adhesive used for the intaglio surface of the ceramic was applied and

Figs 7a to 7c Completed tooth preparation.

Fig 8 Evaluation of the shade and fit using glycerin-based try-in paste. Two different shades were tested: a low-value paste for the right central incisor and a high-value paste for the left central incisor.

also left uncured (Figs 9g and 9h). For the canines, in the cervical area where dentin was exposed due to recession, the phosphoric acid was applied for 15 seconds, and a hydrophilic dentin adhesive (Excite F, Ivoclar Vivadent) was used instead of a hydrophobic one. Light-cured resin cement is the material of choice for laminate veneers due to its easy handling and color stability.

The resin cement was carefully injected to avoid air bubbles, and each veneer was placed. After removal of excess cement, photocuring was performed for 40 seconds in four directions using a light-curing unit in high-power mode (Bluephase, Ivoclar Vivadent) (Fig 9i). A glycerin-based jelly (Liquid Strip, Ivoclar Vivadent) was applied for air blocking. Each surface was light cured for an additional 20 seconds (Fig 9j). A new, sharp scalpel was used to remove excess adhesive and cement. This procedure must be carried out with caution to avoid scratching the ceramic surface.

Fig 9a Rubber dam used for better moisture control.

Fig 9b Abrasion of the enamel surface with the intraoral microetching device.

Fig 9c Right central incisor immediately after air abrasion.

Figs 9d to 9h Bonding procedures. The adhesive was air thinned but not cured.

Figs 9i Photocuring after removal of excess resin cement.

Fig 9j Photocuring after application of the glycerin jelly.

Fig 9k Laminate veneer immediately after bonding to the left central incisor.

Only one veneer was cemented at a time (Fig 9k). After bonding of the six veneers, finishing procedures were performed using abrasive composite resin strips (Flexistrips, Cosmedent). Diamond burs and diamond strips should be avoided during finishing because they can scratch the ceramic surface. Occlusal adjustments were carried with diamond point burs and a ceramic polishing system (Optrafine, Ivoclar Vivadent). Every interproximal space was flossed to check for excess material. Figures 10 to 12 show the final results of treatment.

Fig 10 Final laminate veneers immediately after bonding

Figs 11a to 11c Final laminates veneers 3 months after bonding.

CONCLUSIONS

The ultimate ceramic veneer concept offers high-quality restorations with minimal tooth preparation. This technique can be used for any case in which laminate veneers are indicated and in which the tooth substrate shows no severe shade alterations. The lithium disilicate glass-ceramic restorations provide excellent esthetics and adequate function. When associated with careful bonding and occlusal adjustments, ultimate ceramic veneers fulfill the requirements for long-term clinical success.

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Figs 12a to 12c Final smile after 90 days.

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