Dentistry in “3D”: 
A Smile Makeover with Single-Appointment Porcelain Veneers

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ABSTRACT

The unique methods of computer-aided design/computer-aided manufacturing (CAD/CAM) dentistry provide an exciting alternative to the traditional laboratory-created porcelain veneers that have been a proven solution for smile makeovers. Design techniques have continued to evolve, with new three-dimensional (3D) graphics software that makes the process more intuitive and easier to understand. Improvements in porcelain-handling techniques as they relate to CAD/CAM-created restorations provide superior esthetics in a fraction of the time of lab alternatives. Blending conventional techniques and computer technology into a single visit provides convenience and almost instant gratification for the patient without sacrificing the esthetic and functional result.

INTRODUCTION

The concept of direct-placement restorations usually brings to mind thoughts of amalgam or composite restorative materials. Direct placement need not be limited to these materials, however. Single-visit placement of ceramic materials in posterior regions has been a mainstay of the CEREC® (Sirona Dental; Bensheim, Germany) family of systems for more than 15 years. Inlays, onlays and full crowns have a proven track record of durability, strength, and esthetics. Continual improvements in materials and techniques provide excellent esthetic results in the anterior region and the restorations can still be delivered in a single visit.

Tissue-contouring procedures were designed to achieve appropriate length of the final restorations and bring her smile into harmony with the rest of her facial features.

PATIENT HISTORY

The patient, a 40 year old female registered dental assistant, has worked in the author’s esthetically focused practice for six years. She improved her smile over a period of several years with adult orthodontics, which accomplished realignment of the
arch forms. She had all amalgam restorations replaced with CEREC Vita Mark II (Sirona Dental) restorations during previous treatment episodes. The patient had also completed take-home whitening with the Nite-White system (Discus Dental; Culver City, CA), leaving her teeth at a 0M1 shade from the VitaPan Master 3D shade guide (Vident; Brea, CA). The incisal edges of the six maxillary anterior teeth were severely damaged from rotations and malocclusion prior to three years of full orthodontic care. These areas of abnormal wear led to a “reverse” smile architecture and an occlusal plane canted apically toward the patient’s left (Fig 1). Having observed many smile makeovers while assisting the author, the patient had a definite idea of what she wanted to accomplish for the final step of her esthetic and functional rehabilitation.

**Clinical Examination**

The general condition of the patient’s dentition and periodontium was excellent. General labial flaring of the maxillary teeth was present and an abrasion lesion with lateral interference was noted on the upper left first premolar (Fig 2). Lateral discission was present on the patient’s left, with the cuspids and first premolar both in primary excursive contact. Excusive contact on the patient’s right side was on the second premolars. Slight irregularity of tissue height was also present.

When possible, care should be taken to prepare the teeth in such a way as to have uniform thickness of ceramic in the final restorations of each tooth.

**Treatment Plan**

The patient’s area of prime interest was esthetics; however, functional concerns were of high priority to protect the rehabilitated dentition. An evaluation of the smile form and esthetic factors was accomplished and treatment options were discussed. The patient elected to have porcelain veneers placed on the eight anterior teeth. Tissue-contouring procedures were designed to achieve appropriate length of the final restorations and bring her smile into harmony with the rest of her facial features. Incisal lengthening with open incisal embrasures was planned for the centrals and laterals. Alterations to the buccal corridor were proposed to allow for changes in the buccal flaring and axial inclinations of all eight teeth. Lengthening of the cuspids was prescribed to create proper lateral disclusion and protection of the posterior segment, as well as elimination of the interferences on the maxillary first premolar.

**Preoperative Preparation**

A full-contour esthetic mock-up was performed three days before the preparation day to establish form and function and to help to define the requirements for tissue recontouring. The mock-up was bonded with adhesive techniques for three reasons:

- Adhesive placement allows the patient to live with the new smile for a few days and to approve or request modification of the contours, etc.
- The bonded mock-up serves as a template for the final restorations in much the same way as a vacuum form template is made over a diagnostic wax up.
- Incisal edge positioning, labial arch form, tooth rotations, and other factors influence preparation design.

The mock-up helped guide labial recontouring of the teeth prior to the placement of the resin. The mock-up also helped to develop proper final restorative thickness and prevent overcontouring.
Anesthesia was administered and recontouring of the teeth was begun. Placement of a diamond finishing strip (Axis Dental; Irving, TX) across the labial tissue highlighted the gingival irregularities (Fig 3). The metal-backed, abrasive strip was trimmed in length and curved to the patient's arch form. The abrasive side was gently placed against the tissue to act as a "leveling line" to help evaluate the tissue height. The labials of the upper-right first premolar, cuspid, and lateral were sounded to bone to evaluate for adequate biologic width after tissue recontouring (Fig 4). A #15 Bard-Parker scalpel (Becton Dickinson & Co., Lincoln Park, NJ) was used to scallop and raise the tissue height (Fig 5). Hemorrhage was managed with Expasyl (Kerr; Orange, CA) (Fig 6). The placement of the resin mock-up was accomplished on each tooth individually after the application of etch and Excite (Ivoclar Vivadent; Amherst, NY).
When possible, care should be taken to prepare the teeth in such a way as to have uniform thickness of ceramic in the final restorations of each tooth. This helps to mitigate shade-matching problems that can result from the underlying tooth shade showing through the veneer in differing ways. Uniform thickness of the final restorations was facilitated through the mock-up process. Final contouring was accomplished, the restorations polished (Fig 7), and the patient dismissed until the preparation and delivery appointment.

**Preparation and Delivery Appointment**

The mock-up that had been placed three days earlier was evaluated and modified as necessary to achieve final form and function. An alginate impression was acquired and poured in an “optically correct” stone for use during the CAD/CAM design phase. The patient was anesthetized and preparation begun.

Preparation styles range from minimal labial reduction and beveled incisal finish lines to more aggressive preparations with 0.75–1.0 mm labial chamfers, incisal wrap-over, and lingual finish lines. The existing condition of the tooth, previous restorations, decay, and the anticipated method of characterization influence the choice of preparation styles. Two methods of design give further flexibility in creating restorations. A special “veneer mode” program facilitates quick and easy design of veneers when the preparation is limited to the labial surface and does not wrap over the incisal edge. The 3D “anterior crown design mode” enables the creation of restorations that fully wrap the incisal edge. This design method also allows for more thickness of the incisal porcelain and makes incisal layering of translucent porcelains possible.

Instruments such as the Zekyra gingival retractor (Zenith Dental; Englewood, NJ) can facilitate atraumatic preparation of margins near the tissue. Very careful tissue management is essential because seating of the restorations will occur in this same visit and there is no time for healing of traumatized tissue. The gingivo-interproximal margin was carried to the contact; this ensures that the “elbow” of the margin was hidden behind the adjacent tooth line angle and the crest of the papilla. Once the preparation was completed, the process of the “optical impression” was begun. The “impression” is actually a three-dimensional digital photo of the prepared tooth captured by the CEREC camera, eliminating the need for a typical crown and bridge impression. This digital image is actually measuring the height, width, and depth of the restoration. The subject teeth were thinly painted with “imaging liquid” and then coated with a very fine layer of “imaging powder” that provided the contrast necessary for the program. To ensure stability of the image, a C-Stat (Dentistry by Design, Inc.; San Diego, CA) was placed on the camera body and rested on the adjacent tooth. The camera “senses” the topography of the image with an accuracy of 25 µm by activating the “Acquire Preparation” icon with the foot pedal. The image

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**Figure 8: The optical impression and “digital die trim.”**
was captured in alignment with the path of insertion and allowed visualization of the adjacent contact areas. The image was accepted, thus beginning the design process.

**Design Phase**

The latest step in the evolution of CEREC software is the just released CEREC 3D. The easily understood, three-dimensional graphical interface provides prompts to the user as to the next step of the process. A simple click steps sequentially through the design process, which is viewed live with full 3D rendering. The “optical impression” is followed by a “Digital Die Trim” (Fig 8), which removes the adjacent teeth, leaving the preparation completely visible. The actual preparation margin is drawn almost automatically and is accurate to within 25 µm. The height of contour is proposed and allows the user to orient the position and the height of the proposed shape of the restoration generated by the program. The design proposal is adjusted to fit the shape of the mock-up shape.

Tools have been provided for rotation and scaling of the entire design, section by section. Additionally, a “wax drop” tool allows addition of contour in specific areas. Contact areas are viewed with a color map that indicates contact surface and strength. A three-dimensional “framework” model (Fig 9) is then fed to the milling chamber by wireless RF radio wave transmission to create the restoration. The design time for the restorations is 3–5 minutes and the milling time is between 8–12 minutes. The remaining teeth are alternately prepared during the milling time. A try-in is done and final adjustments to contour are accomplished after the milling of the first restoration. The same process is repeated for each additional tooth to be restored and, when all restorations are completed, all are tried-in together. The esthetic modifications are begun once final contours, incisal edge placement, and contacts are established.

**Materials**

Vita Mark II (Vident; Brea, CA) feldspathic ceramic material was chosen for this case due to its ease of esthetic modification. The composition and characteristics of this material differ from the typical laboratory feldspathic porcelain in particle size and strength. There are eight shades available in the Vitapan Master 3D shade system and five shades in the standard Vita shade range. The industrial process of preparation of the ceramic blanks creates highly favorable qualities. These qualities include consistency of shades; homogeneity of the ceramic, which virtually eliminates porosities; and small particle size, which reduces wear of the opposing dentition. Vita Mark II CEREC block material is compatible with the new Vita VM 7 and Vitadur Alpha porcelains as well as with Vita Akzent (Vident) porcelain stains. This compatibility provides a great deal of flexibility for esthetic modification, including simple surface staining to more intricate internal staining and porcelain layering. These techniques provide a wide variety of esthetic results while still allowing single-visit convenience for the patient.

**Esthetic Modifications**

Simple surface staining and glazing was accomplished on the premolars and cuspids with a single oven firing. Stains were mixed with a glycerin material and applied as required with a fine sable brush. All restorations were characterized and fired simultaneously.

The patient desired a strong incisal translucent effect for the lateral and central incisors that was not possible with surface stains. Because more
extensive characterization was desired, these four veneers were prepared for porcelain layering using a “cut-back” to allow the addition of translucent porcelains (Fig 10). These types of layered modifications have true internal effects rather than surface effects, ensuring long-term esthetic results. The incisals of the milled restorations were shaped to mimic mammalons and create very natural effects. These modifications required two firings. The layered, incisal porcelain materials were fired under vacuum, followed by a non-vacuum firing of the glaze.

A try-in of the final modified restorations was accomplished and the units were prepared for adhesive placement by internal etching with a 5% hydrofluoric acid gel for one minute. The gel was then rinsed and the restorations desiccated prior to coating with a silanation agent. The teeth were then prepared using 37% phosphoric acid and Excite (Ivoclar Vivadent) dentin bonding agent. The
luting agent, Variolink (Ivoclar Vivadent), was applied, the veneers seated, excess removed, and light-cured. Final clean-up, occlusal adjustment, and polishing was accomplished using fine diamonds and porcelain-polishing instruments. The lingual aspect of the restorations were finely polished with polishing instruments (Ceraglaze, Axis Dental) to a surface particle size of 8–10 µm, leaving a surface that is virtually identical to enamel in wear characteristics. While the incisal edges are completed in glazed feldspathic ceramic, the lingual centric occlusion is against the finer, polished Mark II ceramic, which contributes to a lessened amount of wear to the opposing dentition. The materials are well-tolerated by the periodontium, excellent esthetic results were achieved, and patient satisfaction was excellent (Figs 11–15).

**CONCLUSION**

Employing the described techniques gives the dentist and the patient exceptional benefits. The cosmetic mock-up in this case helped the patient visualize her desired form and function and begin to live with her new smile. Nearly all aspects of esthetic form and function were completely worked out “live” in the patient’s mouth. The resultant mock-up “template” provided for nearly exact duplication of contours with the CAD/CAM design. The single-visit nature of this case enhanced convenience and eliminated the need for traditional temporaries. Creation of characterization effects was easily customized to the patient chairside, leaving the ultimate control of the esthetic result in the hands of the clinician. Every aspect of the process is personally fabricated, chairside, by the doctor. This provides unprecedented in-office control to all aspects of the case, including color, form, function, and detailed characterization. The ultimate benefit, however, is to the patient, who was thrilled with the immediate result of her perfect smile (Figs 16 & 17).

**References**