Fabricating a Fixed Partial Denture With CAD/CAM Technology

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Over the last few decades, porcelain-fused-to-metal (PFM) crowns have been used to restore traumatized teeth and to improve compromised form, function, and aesthetics. Although PFM restorations remain a viable treatment option, they may not be ideal for patients with allergies to metal or those with periodontal disease. In recent years, pressable ceramics and computer-aided design/computer-assisted-machining (CAD/CAM) technology have undergone dramatic advancements. CAD/CAM technology can provide a predictable means of fabricating highly aesthetic metal-free restorations for anterior and posterior treatment sites. These systems now make it possible for the fabrication of fixed prosthetic solutions with enhanced biocompatibility, durability, and aesthetics.

Technological advancements in computer software allow CAD/CAM scanning procedures to be performed more easily and with increased predictability so that optimal aesthetics and marginal integrity can be achieved. The scanned image can then be processed or milled to create an alumina oxide or a zirconia substructure. The utilization of zirconia materials in conjunction with CAD/CAM technology also allows the fabrication of single copings and multiple-unit frameworks, which can be veneered with durable porcelain materials. Although some materials have inherent advantages over others, one's understanding of the veneering porcelain, the fabrication technique to be utilized, and proper communication between clinician and technician can maximize the potential of achieving a patient's aesthetic expectations.

Case Presentation

A 70-year-old male patient presented with a cantilever fixed partial denture (FPD) on teeth #9(21) and #10(22). The FPD, which was placed over 20 years prior, had become less than optimal as the soft tissue had begun to migrate due to periodontal conditions and the natural aging process. The patient was reluctant to have treatment performed on his teeth other than the replacement of teeth #9 and #10. The devised treatment plan called for the replacement of these two teeth with an FPD on teeth #9 through #11(23) and the placement of direct composite restorations on teeth #7(12) and #8(11).

Figure 1A. Facial view of the patient's compromised anterior dentition at the time of presentation.

Figure 1B. Postoperative view following placement of the zirconia-based FPD and direct composite restorations on the adjacent teeth.

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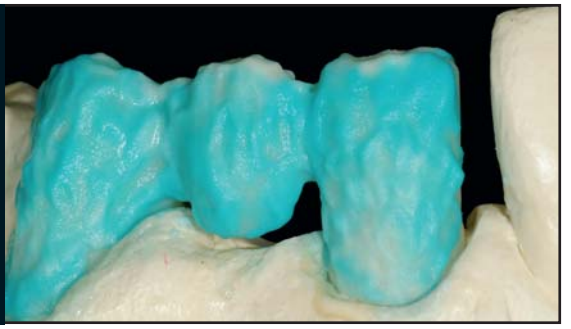
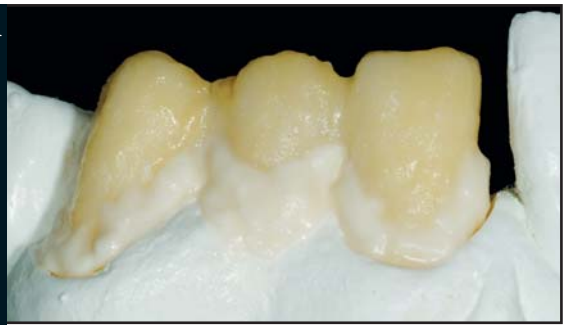
2A

2B

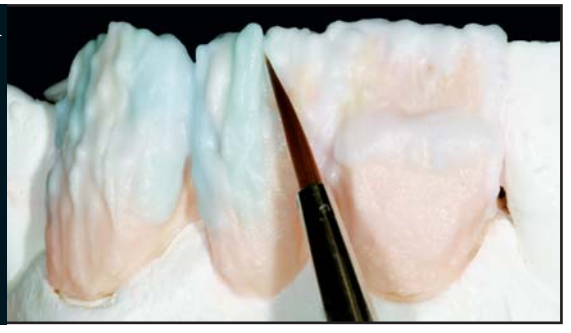


3A



3B

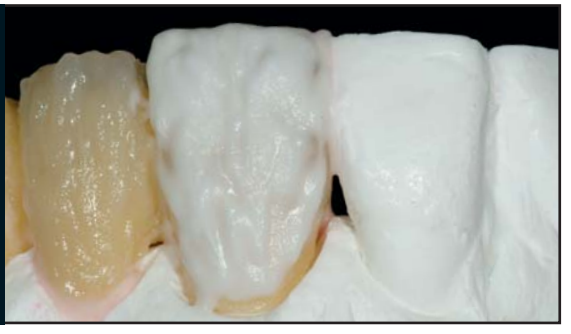
4A



4B

5A

5B



6A

6B

Figures 2A,B,C. Teeth #9 through #11 were prepared to serve as abutments for the FPD. Impressions were made, and the patient was provisionalized. Once the master model was made, it was forwarded for scanning and processing. The models and dies were optically scanned from several different angles, and the resulting images were sent to a milling machine where blocks were milled accordingly. The unit was then sintered at 1500°C for 11 hours. In the dental laboratory, the substructure (ie, Lava, 3M Espe, St. Paul, MN) for the FPD was prepared for porcelain buildup. A foundation layer of porcelain dentin (ie, Initial, GC America, Alsip, IL) was thus applied and fired at a temperature of 810°C and held for 1 minute.

Figures 3A,B,C. Warm and saturated opaque dentin was applied to the gingival aspects, and then a dentin layer was built to full contour. The incisal third was then cut back to create space for the enamel layering and internal characterizations. Space between the characterized dentin substructure was filled with translucent powder to preserve the shape while the enamel and translucent layers were built. The length was extended slightly to compensate for shrinkage that would occur during firing.

Figures 4A,B,C. To create an illusion of depth in the restoration, the enamel layer was applied utilizing the lateral segmentation buildup technique with enamel powders of various shades. Once a thin layer of warm orange-colored opaque dentin was applied on the lingual surfaces, the restoration was covered with dentin and enamel ceramic. The completed buildup was fired at 800°C and held for 1 minute.

Figures 5A,B,C. After the initial firing, an e-pontic site was created on the solid model. As a translucent layer was applied to the restoration, appropriate dentin was layered underneath the pontic, which was subsequently extended to create and shape the edge on the bottom of the pontic. The second firing was done at 790°C for approximately 15 to 20 minutes.

Figures 6A,B,C. Small increments of enamel and translucent ceramic could have been added during baking as needed, before the restoration was finished and the desired surface texture and luster were achieved. The restoration was then returned for final cementation; occlusion was checked for proper occlusal guidance and closure. The enhanced translucency, vitality, and stable color of the FPD were ensured by the sintered zirconia frames, which allowed maximum control of light, strength, and aesthetics.

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