The CAD/CAM Technology Restorative Evolution

Embracing with Excitement and Frequent Assessment—Part II

ARIEL RAIGRODSKI DMD MS

In Part I of this article we reviewed the evolution of CAD/CAM technologies and the wide array of possibilities in terms of restorative materials used and treatment modalities available for both provisional and definitive restorations. In Part II, we will address design options for different types of restorative modalities to facilitate the restorations' durability and aesthetic outcome.

Design Capabilities

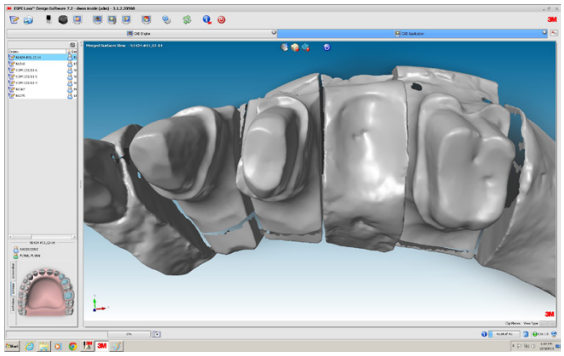
Ideally, design software would allow technicians to integrate and use the same data and design concepts as those used with conventional waxing, investing and casting techniques. The flexibility sustained by the most current CAD/CAM software supports the design of restorations with a hybrid form. Areas subjected to higher mechanical load and areas that are not aesthetically sensitive are designed for complete monolithic contours, whereas areas within the restoration where aesthetics are critical are designed with a cut back (as a partial coping); creating a hybrid design to allow space for layering porcelain to enhance the aesthetic outcome (Figs. 1a and 1b). Conceptually, copings for such hybrid restorations resemble the design of a tooth prepared for a veneer restoration.

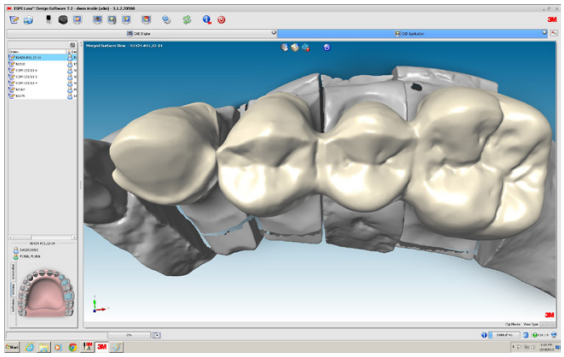
Recent advances in CAD software have enhanced the ability to customize copings for crowns, FDP frameworks and implant abutments, as well as the design of complete contour tooth-borne and implant-supported restorations. Traditionally, complete contour wax-ups were made as a foundation for the fabrication of crowns and FDPs and subsequently cut back to create the framework. That concept may now be applied virtually on the computer monitor via advanced CAD software. Complete contour wax-ups, master casts, interocclusal records and opposing casts can be scanned and their images may be superimposed to create a virtual working model. This technology gives the dental technicians at the CAD unit the ability to design ideal copings/frameworks with optimal support for veneering porcelain for bilayered restorations on a virtual articulator. Similarly, hybrid designs with facial and incisal cut backs or complete contour restorations may be designed and fabricated. The same concepts of design—based on the complete wax-up or the provisional restorations—should be used for the fabrication of custom implant abutments for cement-retained restorations and implant infrastructures (such as bars and superstructures for implant overdentures) as well as single and multiple-unit splinted screw-retained implant-supported restorations (fixed-hybrid, metal-ceramic and all-ceramic) (Figs. 2a and 2b).

As with traditional technology, fit and marginal integrity for CAD/CAM restorations are paramount parameters for success. Research has shown that adequate marginal integrity can be achieved with CAD/CAM restorations with high levels of success. Of course, successful restorations begin with adequate preparation design and accurate impressions, which are the foundation for the fabrication of any indirect restoration, no matter which technique or technology is used in the dental laboratory. Achieving the desired marginal integrity in the dental laboratory is related to a combination of factors, such as the software used to design the restoration, the manufacturing process and the skills of the CAD/CAM system operator. Still, the human factor is significant in the process, from the aspects of both the clinician and the technician, as the fabrication of restorations with CAD/CAM technology is less forgiving than traditional techniques. The communication between the dentist and the laboratory is also critical for clinical success.

CAD/CAM Integration

The constant evolution in computer software and hardware, as well as the ongoing development in dental materials and treatment modalities, continues to contribute to the rapid evolution in CAD/CAM technology. In the quest for greater restorative versatility, the optimal CAD/CAM system will have to support fabrication of





Figures 1a and 1b. Occlusal view of a scanned definitive cast prepared for a bilayered zirconia-based crown on the canine, a fixed dental prosthesis with a monolithic zirconia design on the molar retainer, and a hybrid design on the pontic and premolar retainer.

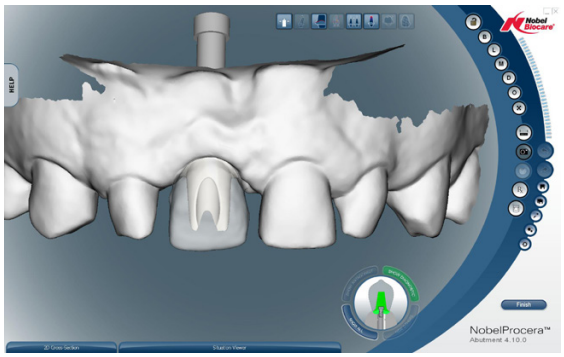


Figure 2a. Facial view of a scanned definitive cast with a designed CAD/CAM abutment for a cement retained implant-supported crown. The design is based on the contours of the superimposed model of the provisional restoration, ensuring adequate support of the soft tissue and space for the prospective restorative materials.

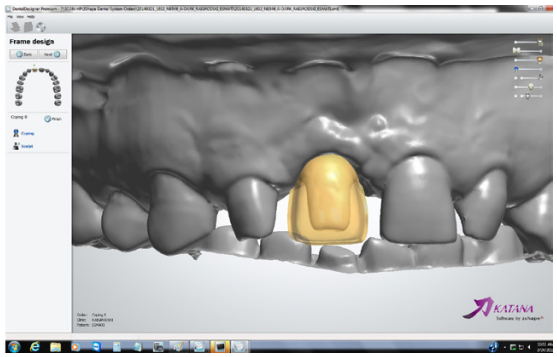


Figure 2b. Facial view of the scanned definitive cast with the abutment in place demonstrating the relationship between the implant abutment (opaque yellow), the coping for the crown (semi opaque) and the layered ceramic (opaque yellow at the circumference of the restoration). Note the coping design resembles a tooth veneer preparation.

consistent and efficient restorations both chair side and in the dental laboratory. Just as cross-platform communication between smartphones, tablets and computer systems continues to rapidly evolve, multiple open platform CAD/CAM systems allow different systems to communicate and integrate data in the process of the restorative sequence. Examples of such emerging integrated uses include the incorporation of CAD/CAM technology at the phase of treatment planning, the use of cone beam computerized tomography (CBCT) to guide and support the production of CAD/CAM surgical guides for precision implant placement, the increased use of digital impressions and the introduction of rapid prototyping and stereolithography as part of the fabrication process. These processes have opened doors to new corridors of opportunity for both technicians and clinicians. However, this requires that all members of the treating team frequently update and improve their skills, knowledge and communication, which will eventually contribute to improved patient care. The future is always just around the corner and is perpetually evolving in the dental laboratories and dental practices of those who embrace it.

Dr. Raigrodski is a diplomate of the American Board of Prosthodontics. He is a professor at the department of restorative dentistry and an adjunct professor at the department of materials science and engineering, both at the University of Washington. Dr. Raigrodski's research focuses in all-ceramics, implants, and CAD/CAM technology. He lectures nationally and internationally and maintains a private practice in Kenmore, WA. Dr. Raigrodski can be reached via email at draigrod@comcast.net or via cell at 206.234.3340.