COPING MATERIALS FOR IMPROVED AESTHETICS: Combining Strength and Aesthetics

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Selection of an appropriate framework will significantly influence the definitive aesthetics of any crown or fixed partial denture (FPD). With the proliferation of precious metal copings and computer-assisted design/computer-aided manufacturing (CAD/CAM) materials, restorative options that provide both strength and appearance have increased. In this feature, considerations for selecting among the many framework and CAD/CAM options are reviewed and their characteristics compared.

CONSIDERATIONS
Aesthetics is a matter of opinion; a product is an extension of the fingertips of the operator, and any product is only as good as the operator. The product may or may not be good, but the trick is to know how and when to use it. Many products on the market today possess the desirable optical qualities of fluorescence and opalescence, but matching the product to the restorative environment is critical to its successful utilization. The goal of the ceramist is to create a lifelike appearance and an illusion of reality, mimicking natural teeth. Coping material and technology are among several factors that influence the achievement of that goal. Choice of the most appropriate framework will be determined by consideration of several factors.

Tooth Mobility
Are the teeth mobile? Is there periodontal involvement? Do the teeth need to be splinted? If splinting is necessary, all-ceramic restoration is not an option. A porcelain-fused-to-metal (PFM) or gold (eg, Captek, Precious Chemicals, Altamonte, FL; Bio 2000, Argent Corporation, San Diego, CA) framework is indicated.

Number of Units
Nonmetal copings have not yet demonstrated the flexural strength necessary for restoration of longer spans. When a restoration of more than three units is planned, PFM, gold, or another metal-ceramic framework is indicated.

Tooth Preparation
Each proprietary coping material requires a preparation to meet manufacturer specifications. This is especially true with copings that are machine-fabricated (eg, Procera, Nobel Biocare, Yorba Linda, CA; Lava, 3M ESPE, St. Paul, MN; Cercon, Dentsply Ceramco, Burlington, NJ). If the coping material has not been selected prior to tooth preparation, and the tooth has not been prepared to the manufacturer’s specifications, framework selection will be limited and many options foreclosed. The technician cannot create the magic of lifelike restorations without sufficient reduction to layer the ceramic and a preparation design appropriate to the intended framework. Clinicians who prepare teeth as they always have for PFM restorations will be limited to placing PFM restorations.

Substrate Color
What is the substrate color? Is it dark? Nonvital? Is a post and core present? If so, what color is the metal of the post, (eg, gray, silver, gold) (Figure 1)? A single tooth without root canals that has been minimally prepared can be beautifully restored with a pressable ceramic (eg, IPS Empress, Ivoclar Vivadent, Amherst, NY; Authentic, Microstar Corporation, Lawrenceville, GA) in which the framework has been encapsulated in the restoration (Figure 2). Because the restoration’s color is a function of the natural tooth color, however, the porcelain, and the cement, an alternative framework is indicated when darkness in the natural tooth is present and will be captured in the pressed-ceramic restoration. If three or fewer units are involved and the teeth are not mobile, this substrate can be blocked with one of the many CAD/CAM products (eg, Cercon, Dentsply Ceramco, Burlington, NJ; Lava, 3M ESPE, St. Paul, MN; Procera Zirconia, Nobel Biocare, Yorba Linda, CA) provided that sufficient space (1.5 mm or more) is available and the ceramist is familiar with the material properties and limitations of whichever product is selected (Figures 3 and 4). Accurate shade

*Figure 1. Preoperative view of a fractured tooth. Minimal postoperative appearance 15 years later. Preoperative view demonstrates compromised flexural strength. Nonmetal copings have not yet been selected prior to tooth preparation, and the tooth has not been prepared to the manufacturer’s specifications, framework selection will be limited and many options foreclosed. The technician cannot create the magic of lifelike restorations without sufficient reduction to layer the ceramic and a preparation design appropriate to the intended framework. Clinicians who prepare teeth as they always have for PFM restorations will be limited to placing PFM restorations.

*Figure 2. Preoperative view of a fractured tooth. Minimal tooth preparation was performed to preserve as much enamel as possible for better bonding strength. (Dentistry by David Garber, DMD.)

*Figure 3. Preoperative view demonstrates compromised substructure preparation color in the anterior crown. Sufficiently reduced, the crown was replaced with an all-ceramic restoration.

*Figure 4. Postoperative appearance 15 years later. Some of the natural tooth color from the preparation was allowed to bleed through. (Dentistry by Cathy Schwartz, DDS.)

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match to the preparation as well as the natural tooth is necessary with any of these technologies, a task that has been simplified with the advent of shade guidance systems such as the spectrophotometer (eg, SpectroShade, MHT International, Newton, PA; ShadeScan, Cynovad, Montreal, Canada) and the colorimeter (eg, ShadeVision, X-Rite, Grandville, MI).

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Gold remains an excellent solution for all restorative cases. In recent years, alloys and composite alloys with very high gold content have come to market that combine the color, burnishability, and biocompatibility of pure gold but also display the compromised strength and oxidation associated with most high-gold alloys. Laboratory technicians have addressed these issues with an internally reinforced and strengthened network of high-fusing platinum, palladium, gold particles (average 15 \(\mu\)m), giving the restoration a “skeleton” that does not melt and become distorted during fabrication of the metalwork. Because oxide does not form on the surface during porcelain firing, graying does not occur at the margins of the copings. A wide
range of porcelains are compatible with the metal, allowing the use of high-, medium-, and low-fusing porcelains for single-unit anterior or posterior crowns and fixed partial dentures of up to six units (Figures 5 through 9). The improved light-dispersing qualities of the resulting crown produce more natural aesthetics than are typically associated with PFM frameworks with minimal tooth reduction.

Most CAD/CAM systems, on the other hand, begin with innately aesthetic and biocompatible core materials and endeavor to produce natural restorations with greater strength than existing all-ceramic alternatives (Table). Competing CAD/CAM systems are distinguished by their technical and procedural characteristics, including:

- The type of scanner used to capture the data (ie, laser, optical, or mechanical);
- Whether the system can produce multiunit or single-unit frameworks, or both.

CAD/CAM manufacturing may be performed within the laboratory or be outsourced to the system manufacturer. With an outsourced system, captured data are scanned with the CAD/CAM three-dimensional software that allows for simplified visualization of the die details. After the scanner operator has determined the margin, the final data are precisely calculated and transferred via Internet for fabrication. After the mathematically controlled shrinkage behaviors of the ceramic powder, the final product is densely sintered in a ceramic coping that fits the original master die at the lab. The coping is then returned to the lab for the ordinary porcelain buildup.

In-house systems equip the laboratory to perform all stages of fabrication on the laboratory premises. Due to industrial repeatability, CAD/CAM-generated
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copings are believed to improve consistency and reduce reliance on the subjective skills of the technician, which allows the laboratory to focus more on the aesthetic aspects of restoration (eg, porcelain buildup). This focus on other value-added steps in the production cycle, overall efficiency, and consistency in quality helps improve lab return on investment.

CONCLUSION
The PFM restoration remains the restorative workhorse when teeth are mobile and require splinting, when

FIGURE 9. Postoperative appearance of the splinted restoration. The blend is harmonious with the adjacent tooth structure. While both restorations were acceptable to the patient, the splinted gold substructure was selected due to tooth mobility.

(Dentistry by Henry Salama, DMD.)
tooth color is so dark that a translucent restoration will be unaesthetic, and/or when fixed partial dentures in excess of six units are planned (Figures 10 through 13). When these conditions are not present, the clinician and the laboratory may choose from a growing selection of framework materials that advance the goal of achieving a lifelike look.

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