## Ask the Experts

## METAL-FREE DENTISTRY

Guest Expert Terry E. Donovan, DDS\*

QUESTION: With all of the advances in high-strength and zirconiareinforced ceramics, are metal alloys obsolete in restorative dentistry?

ANSWER: Unquestionably, there have been many new "high-strength" all-ceramic systems aggressively marketed to the profession in recent years. The development of these "improved" materials has occurred simultaneously with a significant demand for improved esthetics. The intelligent practitioner should carefully examine the claims of manufacturers regarding these contemporary all-ceramic systems and their ability to legitimately provide an improved esthetic result. They must also demand a reasonable evidence base relative to potential length of service to support their confident clinical use. The criteria developed by Scharer seem to be reasonable and appropriate (3-5 yr documented clinical use, 95% success rate).1

Some practitioners aggressively market their practice as a "metalfree" practice, implying that such an approach is inherently superior to a more traditional approach.<sup>2</sup> However, metal-free dentistry is neither desirable nor beneficial for patients. Ethical practitioners offer a variety of services to their patients, who then select procedures based on their personal needs and preferences. These factors include esthetic demands, concerns for restoration longevity, and cost-benefit considerations, among others.

There are many situations in which metal-based restorations are the restorations of choice. Although the indications for use of silver amalgam are clearly decreasing in developed countries, there are many specific lesions for which silver amalgam is the material of choice, and it remains the most cost-effective material available to restorative dentists.<sup>3</sup> In the hands of a competent clinician, cast gold continues to provide well-documented, longterm clinical service, often without compromising esthetics.<sup>4</sup> The indiscriminate use of undocumented ceramic materials on second molars, which is illustrated frequently in

many of the "trade" journals, is to be deplored.

One of the most difficult decisions facing clinicians is related to metalceramic crowns versus all-ceramic alternatives. Metal-ceramic crowns continue to be the most frequently used full-coverage restoration, and when coupled with the use of porcelain facial margins, proper tooth preparation, and soft tissue management, provide the best combination of decent esthetics and clinical longevity.5-7 All-ceramic restorations are indicated when achieving optimum esthetics is more important to the patient than achieving maximum longevity.

When choosing an all-ceramic system, the clinician must first ensure that the system chosen actually provides the anticipated esthetic benefit. Many of the allceramic alternatives gain their

\*Professor and director, Advanced Education in Prosthodontics Program, University of Southern California School of Dentistry, Los Angeles, CA, USA improved strength characteristics through the use of an internal opaque core. These systems do not have any improved ability for light transmission over metal-ceramic crowns, and hence have no inherent potential for improved esthetics.

Clinicians should not indiscriminately use an all-ceramic system until an appropriate evidence base has been established to support it. It is my opinion that the one system that meets both the requirements of using an internal translucent core and has an adequate evidence base is the original IPS Empress crown (Ivoclar North America, Amherst, NY, USA).8 These restorations should be limited to use on anterior teeth because the failure rate in molars with all-ceramic crowns is seven times that on anterior teeth.9 One disadvantage of this system is that it must be cemented with a dualcure resin cement. Resin cementation with subgingival margins is often difficult and problematic.

Laboratory studies that demonstrate very high strengths with allceramic systems are absolutely not predictive of clinical performance owing to the nature of ceramic failures. These failures are related to flaw propagation and static fatigue.<sup>10</sup> Many of the newer systems using computer-aided design/computer-aided manufacturing (CAD/CAM) technology and alumina or zirconia cores have demonstrated very impressive strength values in laboratory trials. These systems may prove to be efficacious over time but have not currently established a sufficient clinical evidence base to recommend routine use in clinical practice. Anecdotal reports with some of these systems indicate that the core materials are very fracture resistant but that a frequent clinical problem is fracture of the ceramic veneer off the core material. Clinical trials are needed to determine whether this is a serious problem.

Manufacturers are marketing many of these systems as materials indicated for the fabrication of posterior crowns and fixed partial dentures. The reader is cautioned that all-ceramic fixed partial dentures are extremely experimental at the time of writing. Until clinical trials are published that support the routine use of such systems, fixed partial dentures are optimally fabricated using metal and ceramics.

Much has been written concerning the biocompatibility of metal alloys, and it is important to understand that there are significant differences among metal alloys in this regard.<sup>11</sup> Although it is possible that a patient could be allergic to any element—even gold—in an alloy, most dental alloys are biocompatible for the vast majority of patients. Most inflammatory soft tissue reactions around metal-based ceramic crowns are the result of biologic width violations or anatomic overcontour, rather than allergy. However, one group of alloys is extremely problematic and in my opinion, should be avoided without exception. These are the nickel-chromium-beryllium base metal alloys intended for ceramic bonding. The incidence of nickel allergy is very high (22% of women, 10% of men) and may be increasing. Beryllium can be a risk factor for pulmonary disease in laboratory technicians. The casting shrinkage of these alloys (2.4%) is almost double that of conventional alloys, leading to compromises in fit. Additionally, the long-term porcelain bond to the metal substructure is questionable owing to oxide propagation. Such alloys are popular because of their relatively low cost, but the disadvantages far outweigh the minor economic benefits.

Clinicians must request that their laboratory use specific alloys in particular clinical situations. For single-unit anterior crowns, the use of a high gold alloy (typical composition 85% gold, 7% platinum plus trace elements) is recommended. The gold color of the alloy makes it possible to use less intense opaque porcelains and enhances esthetics. The primary disadvantage of high gold alloys is a relative lack of strength, so they should not be used for fixed partial dentures or for crowns on posterior teeth. For these situations, a high noble alloy (typical composition 53% gold, 33-38% palladium, 5% silver plus

trace elements) is recommended for its high strength, predictable porcelain bonding, and biocompatibility. The major disadvantage is that a more intense opaque layer is needed to mask the darker metal oxide. All major alloy manufacturers have alloys in these categories.

## SUMMARY AND CONCLUSIONS

Although many advances have been made with high-strength allceramic crowns, they should continue to be used with caution and only in those patients who demand the ultimate in esthetics or who have a demonstrated allergy to specific metal elements. With proper tooth preparation, the use of porcelain facial margins, soft tissue management, and alloy selection, metal-ceramic restorations continue to be the routine choice when an esthetic full-coverage restoration is required. Metal-ceramic restorations provide optimum longevity and decent esthetics.

As new all-ceramic systems are introduced to the profession, clinicians should objectively determine their true esthetic potential and demand evidence from controlled clinical trials before routinely using them.

Clearly, metal alloys in dentistry are not obsolete!

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