The all-ceramic restoration dilemma

Where are we?

Porcelain-fused-to-metal (PFM) restorations became available to the dental profession in the late 1950s. By the mid-1960s, they were becoming popular as an alternative to porcelain jacket crowns and three-quarters-gold alloy restorations. The concept of fusing ceramic to metal was criticized by some clinicians, because gold alloy restorations were the state of the art, well proven and long lasting. At that time, criticism of PFM included complaints such as wear of opposing tooth structure, necessity for deep tooth preparations, only moderate esthetic acceptability, poor fit of restorations and use of base metals for substructures.

Nevertheless, the PFM restoration gradually became the most acceptable esthetic alternative to clinicians considering placing full-crown restorations in the esthetic zone of the mouth. A few years ago, about 70 percent of crowns placed in the United States were PFM, but that percentage has dropped to about 50 percent, as reported by a major dental laboratory (James Shuck, vice president of sales and marketing, Glidewell Laboratories, Newport Beach, Calif., oral communication, April 11, 2011). Something has happened to reduce the percentage of PFM restorations. Numerous all-ceramic restorative materials have been introduced, some with apparently acceptable potential to serve adequately. Table 1 shows the change in use patterns of U.S. dentists during a 13-year period as reported by Glidewell, which produces about 1 million crowns per year. Table 2 shows the types of restorations Glidewell produced in 2010, about 50 percent of which were PFM and about 50 percent were nonmetal (mostly ceramic, with a small number of resin-based composite restorations).

In this column, I will discuss the apparent reasons for the change from PFM to all-ceramic restorations; compare full-contour zirconia restorations, zirconia-based restorations, and lithium disilicate and leucite-reinforced ceramics; and make predictions for the future of ceramic restorations.

**WHAT TYPES OF FULL-CROWN RESTORATIONS DO PATIENTS WANT?**

Is there anyone who has any doubt about what kind of full-crown restorations patients desire? As a practicing prosthodontist, I have seen the introduction of PFM, the rapid evolution of PFM into the dominant material for crown restorations, and the relatively rapid and obvious decline in PFM use in the last several years.

In my experience, most patients want tooth-colored indirect restorations, regardless of whether such restorations are in their best interest. I believe patients are more discriminating and esthetically conscious now than ever before. Even though dentists typically provide in-depth information to patients about the greater longevity and higher strength of cast-gold alloy restorations, many patients elect to have tooth-colored restorations. I have found that some older patients understand the desirability of gold alloy restorations, because they have a historical perspective. In addition, most of my dentist patients want gold alloy restorations. The remainder and majority of patients want tooth-colored indirect restorations. Some even demand that no metal be used in the tooth-colored restorations, thereby eliminating PFM as a restorative option.

Where are we as a profession in recognizing this dilemma and coping with it? Informing patients thoroughly about alternatives for crown and fixed prosthesis materials is essential, but do we dentists know enough about the alternatives?

It has been my observation that dentists are confused about the difference between zirconia-based restorations and full-contour zirconia restorations. Zirconia-based restorations contain a minimum of 0.3 millimeter (anterior teeth) and 0.5 mm (posterior teeth) of zir-
conia as a framework under-structure, much like PFM restora-
tions have metal frame-
works. Ceramic then is layered or pressed over the surface of
the zirconia. Laboratory techni-
cians, attempting to cope with
the underprepared or minimal-
ly prepared tooth prepara-
tions that they often receive
from dentists, decided in frus-
tration that placement of lay-
ered or pressed ceramic on the
exterior of the zirconia may not
be necessary—and thus they
developed the full-contour zir-
conia restoration without
superficial layered or pressed
ceramic.

Full-contour zirconia restora-
tions, just as the name implies,
are full-contour zirconia
without superficial ceramic.
The term “monolithic” has been
used to describe such restora-
tions and others, usually
implying that they are all one
material without an overlay.

ALTERNATIVES FOR
TOOTH-COLORED SINGLE-
TOOTH RESTORATIONS

According to James Shuck of
Glidewell (oral communication,
April 11, 2011), PFM restora-
tions composed about 50 per-
cent of indirect tooth-colored
crowns and fixed prostheses in
2010 (Table 2). Almost all of the
remaining 50 percent were all-
ceramic restorations, as shown
in Table 2. The following are
alternatives for single-tooth all-
ceramic restorations, discussed
in order of their decreasing use,
as shown in Table 2.

Full-contour zirconia res-
torations. It has been amazing
to see the rapid growth of full-
contour zirconia crowns and
fixed prostheses in the past
year. Many laboratories are
promoting the strength and
acceptability of these restora-
tions with great enthusiasm;
the advertisements in dental
journals and magazines are
highly optimistic about the
potential for full-contour zir-
conia restorations.

Clinicians’ observations of
these restorations serving in
the mouth, as offered by partici-
pants in my continuing educa-
tion courses, are optimistic, but
with reservations. Full-contour
zirconia restorations are only
moderately esthetically accept-
able when compared with alter-
natives. Laboratories and basic
scientists are working to over-
come this challenge. In the
meantime, it is apparent from
the market growth of full-
contour zirconia restorations
that dentists and their patients
prefer strong and moderately
esthetically acceptable restora-
tions instead of beautiful but
questionably strong restora-
tions. How much research is
available regarding full-contour
zirconia restorations? Answer: a
minimal amount. Most of the
predictions relative to the serv-
iceability of full-contour zir-
conia restorations must be
extrapolated from the long-term
research on zirconia-based re-
storations discussed in the next
section. However, some pub-
lished articles and abstracts,
mainly related to wear of
opposing teeth by zirconia, are
promising.1-8

Zirconia-based resto-
tations. The zirconia-based resto-
ration concept was introduced
about 10 years ago and now has
been the subject of a significant
amount of basic science and
clinical research, as well as
clinical observation.9-16 The ini-
tial optimism about the concept
cooled somewhat a few years

### TABLE 1

<table>
<thead>
<tr>
<th>INDIRECT RESTORATION TYPE</th>
<th>PERCENTAGE† OF TOTAL RESTORATIONS PRODUCED AT GLIDEWELL LABORATORIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Porcelain Fused to Metal</td>
<td>72</td>
</tr>
<tr>
<td>Metal</td>
<td>12</td>
</tr>
<tr>
<td>All-Ceramic and Resin-</td>
<td>16</td>
</tr>
<tr>
<td>Based Composite</td>
<td>50</td>
</tr>
</tbody>
</table>

† Percentages are approximate. Source: Glidewell Laboratories, Newport Beach, Calif., oral communication, April 11, 2011.

### TABLE 2

<table>
<thead>
<tr>
<th>INDIRECT RESTORATION TYPE</th>
<th>PERCENTAGE† OF TOTAL RESTORATIONS PRODUCED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Porcelain Fused to Metal</td>
<td>50</td>
</tr>
<tr>
<td>Full-Contour Zirconia</td>
<td>20</td>
</tr>
<tr>
<td>Zirconia Based</td>
<td>15</td>
</tr>
<tr>
<td>Lithium Disilicate</td>
<td>12</td>
</tr>
<tr>
<td>Leucite-Reinforced Ceramic</td>
<td>+1</td>
</tr>
<tr>
<td>Resin-Based Composite</td>
<td>+1</td>
</tr>
</tbody>
</table>

† Glidewell Laboratories is located in Newport Beach, Calif.
ago, as researchers found that zirconia-based restorations experienced more clinical failures than did PFM restorations. The reported failures primarily were in the external ceramic and not in the zirconia substructures. Most of the weaknesses of these restorative materials now have been identified and overcome by the respective manufacturers. These restorations can be beautiful, owing to the lack of metal substructure and laboratory technicians’ expertise in layering, pressing and staining the external layers of ceramic.

**Lithium disilicate restorations.** In the past several years, according to James Shuck of Glidewell (oral communication, April 11, 2011), use of lithium disilicate in monolithic pressed or milled single-tooth restorations, crowns, partial crowns, onlays and inlays has grown significantly. In my observations and discussions with many dentists about their experiences to date with this material, I have encountered near-universal optimism. The esthetic result produced by either pressed or milled lithium disilicate is impressive. The material is provided by only one company, Ivoclar Vivadent (Amherst, N.Y.), under the brand name IPS e.max. The results of both basic science and clinical research studies of the product have been positive.

**Leucite-reinforced restorations.** In the past several years, use of leucite-reinforced pressed or milled single-tooth restorations, crowns, partial crowns, onlays and inlays has decreased significantly, probably owing to the increased promotion and acceptance of lithium disilicate restorations. This material has been successful when used in adequately placed single-tooth restorations.

**Alternatives for tooth-colored multiple-tooth restorations.** Numerous all-ceramic materials are being promoted for use as multiple-tooth restorations. Some are being suggested only for anterior and premolar use. However, in my opinion, the strength characteristics of the previously discussed tooth-colored restorations appear to allow only three of them to be used for multiple-tooth fixed prostheses without concern. PFM is the long-proven material for multiple-tooth fixed prostheses. Zirconia-based restorative materials, now that they have been the subject of enough long-term research, are a valid choice if the restorations are made properly by laboratory technicians and cemented well by dentists. Full-contour zirconia restorations appear to be sufficiently strong for use as multiple-tooth fixed prostheses, if one extrapolates from research data regarding zirconia-based restorations. Caution is warranted until more research and observation are available regarding long-term clinical use.

**Summary.** Dental patients typically want tooth-colored indirect restorations in spite of the known greater longevity of all-metal restorations across more than 100 years of observation. Full-contour zirconia restorations have grown rapidly in use for both single-tooth and multiple-tooth fixed prostheses in the past year, increasing in acceptance more quickly than have zirconia-based restorations for the same uses. Concomitantly, lithium disilicate restorations for single-tooth restorations have shown nearly the same growth as that of full-contour zirconia restorations, while use of PFM restorations for both single-tooth and multiple-tooth prostheses has declined. I suggest that use of the described three most popular materials will continue to increase both as conventional indirect restorative procedures and with in-office computer-aided design/computer-aided manufacturing. Continuing success will encourage their increased use and support their acceptability.

I encourage clinicians to be observant of ongoing research and to be cautious in accepting any new concept until at least five years of clinical observation has validated in vitro research findings. PFM still is the most proven of all of the materials discussed in this article.

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The views expressed are those of the author and do not necessarily reflect the opinions or official policies of the American Dental Association.

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7. Oguchi RC, Sanchez-Jorge MI, Sanchez Turrion A. Evaluation of fit of zirconia posterior bridge structures constructed with different scanning methods and preparation.