A few years ago, when zirconia first appeared on the market as an alternative framework material for crowns and bridges, the question of the material’s stability was center stage. More recently, it is no longer disputed – although not yet heavily documented – that zirconia restorations are stable in the long term. The next topic that came to the forefront in dental technology focused on the esthetics of the particular ceramic. The answers coming in are now very promising for the zirconia user. Hubert Schenk has keenly observed the market over the last few years and has intensively focused on the question of esthetics. In the following article, he shows how to achieve standard esthetic results with this high-performance ceramic – and even to exceed them.

**FROM METAL-CERAMIC TO ZIRCONIA**

The very nature of metal frameworks represent an aesthetic hurdle. But the veneer ceramics for metal-ceramic are now so good that we can effectively cover metal frameworks if space permits and a thick healthy gingiva is present. When we are faced, however, with less-than-ideal initial conditions – a frequent occurrence in our daily work – it is more difficult to obtain an esthetically pleasing result with metal-ceramic than with all ceramic. The big advantage of zirconia is that it’s a metal-free restoration material that clearly permits an esthetic result in considerably more cases than before.

I have worked previously, for esthetic reasons, with aluminum oxide. When zirconia became a popular topic a few years ago, the major argument against it was esthetics. So when I began to work with it, I wanted to settle this question of the esthetics of zirconia once and for all.

**DOES ZIRCONIA WORK FOR ESTHETICS?**

I can readily answer the question of whether zirconia can also play an esthetic role. Based on my experience over the last several years, the answer is Yes. The following three case reports will provide the evidence.

**CASE REPORT 1**

The first case involved anterior all-ceramic crowns. There was a natural abutment available at tooth 8 for the restoration, but an implant insertion was needed at tooth 9 (Figs. 1-4).

To allow the gingiva sufficient time to heal before the definitive restoration, we prepared a prefabricated long-term provisional from a light-cured composite (Figs. 5-6).
Figs. 1-2. Model situation in the first case, before and after an implantation at tooth 9.

Fig. 3. The abutment at tooth 9 is titanium and was veneered with the titanium ceramic GC Initial Ti.

Fig. 4. The inserted abutment at tooth 9 alongside the natural abutment at tooth 8.

Fig. 5. The long-term provisional in composite.

Fig. 6. The long-term provisional in situ, about nine months after insertion.
"What is remarkable is that using zirconia with Dynamic Dentin can achieve a much better effect than metal-ceramic."

We started work on the definitive restoration after the patient wore the long-term provisional for nine months. I obtained prepared frameworks from Enrico Steger. The Steger zirconia tooth system (available in the U.S. in late 2006) allows you to choose between two different grades of translucency: very concealing (ICE Zirkon concealing) for heavily discolored abutments and translucent (ICE Zirkon translucent). When selecting a framework material, make sure that it can be stained. White frameworks can be esthetically prepared with A1 or A2, but from A3 upward it becomes quite difficult to obtain an esthetically satisfying result.

The frameworks in this case consist of ICE Zirkon translucent, shade A1; it has been shortened slightly to accept a ceramic shoulder (Fig. 7). I use diamond-impregnated tools from Adident for adapting and working the frameworks.

I do not use a liner, instead I use the Dynamic Dentin principle illustrated by Cristiano Broseghini (DD 1/2002). For this I used two parts of opaque shoulder material, one part of transparent shoulder material and one part of Inside. Using this mixture, I customized the specific shades for the framework and evaluated the framework copings under UV light (Figs. 8-10). The mixture must match the shade to be reproduced.

When layering, I changed very little from what I do when working with metal. The layering techniques are basically identical. What is remarkable is that using zirconia with Dynamic Dentin can achieve a much better effect than metal-ceramic, meaning that with all-ceramics I can integrate the framework much more explicitly into my esthetic design.
Fig. 11. Layer build-up of the Inside materials to close the proximal spaces.

Fig. 12. Layering plan with liners, shoulder materials and Inside materials.

Fig. 13. The entire tooth form is build-up with different dentins.

Fig. 14. The dentin core after the cut-back.

Fig. 15. Build-up of the incisal materials.

Fig. 16. The incisal frame is finished.
Layering begins with closure of the proximal spaces with Inside (Fig. 11). The arrangement of liners, shoulder materials and Inside material is shown in Figure 12. I sketched out this layering plan, as well as those that follow, during the shade registration session.

I first built up the entire tooth form with different dentins (Fig. 13), so that I could determine my spatial needs for incisals and transparent materials more precisely through the dentin cut-back.

Figure 14 shows the dentin core and cut back. Next, I built up the tooth form again with incisal material, both incisally and proximally, and I enlarged it to offset the shrinkage expected from firing (Figs. 15-16). A breakdown of the layers may be seen in Figure 17.

Layering plan for the dentin and incisal material.

Next came layering the mamelons with Inside materials (Fig. 18). We applied the transparent material (in this case CT 21) over the entire surface as an intermediate layer, just as you see it in a natural tooth (Fig. 19).

This gave a transparent intermediate layer like the natural tooth. In this case, I used either CL-F or CT 21 (Fig. 20). The difference between these two transparent materials is that the CT 21 is more strongly fluorescent and less transparent. In a restoration with high brightness, CT 21 is the material I prefer for the intermediate layer.

Next, the build-up was covered with different incisal and transparent materials, previously selected during shade registration (Fig. 21). In the palatal area, Inside was thinly layered incisally as an opaque.
Fig. 21. The build-up was covered with enamel and transparent materials, previously selected during shade registration.

Fig. 22. Inside materials were applied palatally.

Fig. 23. We finished the palatal form with enamel and transparent materials.

Fig. 24. Layering plan for the mamelon structure, transparent intermediate layer, and the enamel and transparent materials.

Figs. 25-27. The crowns must be fired according to the manufacturer's instruction. Underfiring must be avoided at all costs because it will alter the physical and esthetic qualities of the porcelain. The appearance of this zirconia veneer ceramic is different from what we are accustomed to in metal-ceramics. It always appears as if slightly overfired.
"Take particular care to select the firing temperature that suits your furnace and not blindly adhere to the manufacturer's specifications."

dentin (Fig. 22). We finished the palatal form with incisal and transparent materials (Fig. 23). This layer build-up may be seen in Figure 24.

During ceramic firing, take particular care to select the firing temperature that suits your furnace and not blindly adhere to the manufacturer's specifications. I started with the manufacturer's specifications and test fired our furnace until I got the correct temperature. To do this, you must know what a correctly fired crown looks like. If the visual appearance of the fired ceramic dictates the need for a temperature different than the one recommended in the manufacturer's specifications, this is common and should not bother us (Figs. 25-27).

During the bisque bake try-in, be sure to subject the restorations to a functional test and esthetic analysis (Fig. 28). If necessary, use incisal and transparent materials to make any corrections. Thereafter you can work, glaze fire and machine polish the restorations in your customary manner (Fig. 29 and 30). Upon completion, subject the restorations again to a functional test and esthetic analysis (Fig. 30). Figures 31-34 shows the final result in situ.

CASE REPORT 2
The next case is a 70-year-old patient who required six zirconia single restorations in the maxilla at teeth 6–11 (Fig. 35). The tooth abutments were heavily discolored, so I quickly decided on the opaque Zirkon dental framework (transparency grade: ICE Zirkon concealing). The procedure I followed was similar to that described above (Figs. 36-41).
Figs. 31-33. The esthetic integration of the two zirconia single-tooth restorations in the maxilla at tooth 8 and tooth 9 (9 is implant-supported) in their oral environment.

Fig. 34. Smile.

Fig. 35. Initial situation of the second case report, in which six maxillary single restorations in zirconia were needed at teeth 8-11.

Fig. 36. The opaque frameworks with fired ceramic margins.
"Zirconia represents a striking new material because of its exceptionally high strength."

CASE REPORT 3

In the third case, I prepared frameworks for the restorations needed at teeth 8 and 9 from the HIP zirconia Digison. Digison demonstrates a limited but moderate translucency and therefore is only suitable for heavily discolored abutments. In this case, we dealt with mild abutment discoloration at tooth 8. Figures 42-47 provide a brief overview of the case.

CONCLUSION

Zirconia represents a striking new material because of its exceptionally high strength. It passes esthetics-comparison tests against metal-ceramic with flying colors. Zirconia is universally applicable as a framework material. In conjunction with modern veneer ceramics, it offers the advantage of an all-ceramic system, which is remarkable because it enables good esthetics even under variable light conditions. I can cover a wide range of indications with zirconia and also obtain the side benefit that the material can be worked without problems. Neither bubbles nor cracks appeared in about 400 units we prepared, even when restorations were fired repeatedly.

We need to include the zirconia framework as part of our esthetic armamentarium if we wish to reap the full benefits of all-ceramics.
Figs. 42-43. The finished zirconia restorations on a Digizon base.

Figs. 44-47. The esthetic integration of the two zirconia single restorations at teeth 8 and 9 in their oral environment.
PRODUCT LIST

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**Bio**

Hubert Schenk obtained his dental technology education in Italy, graduating in 1985. Four years later, he moved to Germany and worked in the dental laboratories of Jan Langner, Rainer Janousch, and the in the dental office lab of Dr. Hans-Peter Beer and Thomas Oppenberg, DMD, in Munich. Since 1998, he has been running his own dental laboratory. Hubert Schenk is a member of Dental Excellence and is in demand for continuing education courses and presentations both nationally and abroad. He specializes in fixed restorations and has concentrated on the use of zirconia for over two years.

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