Fixed aesthetic restorations
Combining implantology with dental CAD/CAM technology
By Dr Dario Žujic, DT Velimir Žujic, Croatia & DT Dragan Stolica, Slovenia

Full-arch implant-supported superstructures can be achieved by various methods. Depending on the bone quality and number of implants, the patient may either receive a fixed or removable implant restoration. If a fixed prosthesis is indicated, the superstructure may either be cemented or, alternatively, screwed directly to the implant fixture, depending on the clinical situation.

In the case described here, we opted for a cemented zirconium oxide bridge. Monolithic crowns were used in the posterior region.

The seven implants in the edentulous jaw were to be connected to a fixed bridge made of zirconium oxide. The seven implants (Replace CC, Nobel Biocare) were planned and placed. An adequate primary stability of 30 to 35 Ncm was achieved. During the healing phase, the patient wore the existing denture that had been relined with soft silicone.

After a six-month healing period, a satisfactory level of osseointegration was achieved, without any signs of bone resorption or inflammation. The implants were uncovered and gingiva formers inserted. Two weeks later, an impression was taken to transfer the position of the implants to the dental lab. After model fabrication, appropriate abutments were selected and adapted to achieve a common insert direction for the bridge.

The full contours of teeth 13 to 26 were planned to be received with standard 5A-D shades to be recreated efficiently and reproducibly. A sinter support structure was designed to allow the restoration to be sintered in an upright position in the Programat 31 sintering furnace. The sinter frame minimizes distortion during sintering and is instrumental in achieving a high accuracy of fit in long-span objects. Finally, the program calculated the milling data in a process that took less than three minutes to finish.

Fig. 1: The seven implants in the edentulous jaw were to be connected to a fixed bridge made of zirconium oxide. (above) and abutments (below).—Fig. 2a & b: In front, the restoration was designed in full contour and then cut back to the visible aesthetic region. (Fig. 4) Nesting of the bridge framework in the CAM software.—Fig. 3a & b: After milling, high precision result with framework prior to sintering excellent marginal accuracy (incisal, occlusal).—Fig. 4: Shading the interior crown surfaces and basal surfaces.—Fig. 5: Customised framework prior to sintering.

The implant-supported superstructure of implants and abutments was designed as a virtual model using a CAD/CAM program. This enables the possibility to simulate the future restoration and any possible modifications before the actual milling process takes place.

The completed CAD design divides a virtual framework into 18,000 to 20,000 coordinates and generates a harmonious surface texture and perfect marginal seal. The completed design was transferred to the CAM unit.

We use the V3 CAM version, which gives us the option to choose between different output formats. The Zenocam 3.2 format is our preferred output option because, in contrast to the open STL format, it provides information on the specified cement gap, implant axes and IM cylinder diameters. The CAM software uses this information to calculate milling parameters that distinguish between the different areas of the restoration. For instance, when milling the restoration margins, the unit reduces the speed, feed and feed rate to prevent thin crown margins from breaking or fracturing. As a result, even wafer-thin cervical margins having a thickness of as little as 0.1 mm can be reliably milled.

After the output format has been entered, a milling strategy using 2.5 mm, 1.0 mm and 0.7 mm burs was selected for the production of the bridge. The option of using a 0.5 mm bur was not taken as it was not needed for the restoration in question. Next, the job was placed in a virtual Zenostar blank (Fig. 4). We decided to use a translucent, pre-shaded zirconium oxide disc in the shade T sun, because the posterior teeth from 14 to 16 and 24 to 26 were planned to be restored with monolithic zirconium oxide. The warm, redish shade of this disc closely matches the selected tooth shade and allows the A3-D shades to be recreated efficiently and reproducibly.

Milling
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Customising the framework

Once the milling was completed, the framework and the sinter support structure were separated from the disc. In the next step, the unsintered bridge was customised with colouring liquids using the infiltration technique. The range of Zenostar Color Zr liquids is perfectly suited for this purpose, as they are supplied in the standard shades of the A–D shade guide. Five Effect shades are available for further customisation. We used Zenostar Color Zr in shades A2 and A3 as well as the grey-violet Effect shade.

In order to render the infiltration of the individual liquids visible, the virtually colourless liquids were mixed with a visualiser (Zenostar Visualizr). First, the individual areas were customised with a di- luted version of grey-violet Effect shade and Zenotec Color Optimizer mixed with blue Visualizr liquid (Fig. 7). It is essential to use a separate brush for each shade. After having been allowed to dry for two hours, the framework was sintered in the Programat S1.

After the sintering process, the restoration exhibited an excellent accuracy of fit, without the need for any adjustments by grinding. As the framework already exhibited a pleasing basic shade, we simply be a restoration that looks good on the model but appears too bright in the mouth.

The incisal area of the anterior teeth and the cusps of the posterior teeth were customised with a mix of yellow Zenostar Visualizr(Zr) shade A3 mixed with red Visualizr liquid. The incisal third was infiltrated with blue Visualizr liquid.

After the liner firing, the monolithic crowns did not appear brighter than the veneered crowns. The result would simply be a restoration that looks good on the model but appears too bright in the mouth.

The simulation in Figure 9 demonstrates how difficult it would have been for us to achieve the desired tooth shade if we had used opaque white zirconium oxide for the framework. Despite the high translucency of the zirconium oxide, the titanium abut- ments did not show through the framework.

The cemented bridge pleases with its beautiful natural appearances and meets the patient’s functional and aesthetic expectations.

Individual framework refinements

An optimum aesthetic outcome is only achieved if the restoration exhibits ideal optical properties. A controlled brightness value, adequate saturation and translucency and minimised light reflection are essential to achieve a pleasing aesthetic outcome. If these parameters are not met, the result will never be satisfactory, even if the restoration is veneered with ceramics. The result would simply be a restoration that looks good on the model but appears too bright in the mouth.

Staining the zirconium oxide prior to sintering is the first measure to control the light reflection effects. Application of a liner is the second measure. The bridge was veneered with IPS e.max Ceram. As the framework already exhibited a pleasing basic shade, we applied a mixture of IPS e.max Ceram ZirLiner Clear and Incisal (70:30). ZirLiner Incisal reduces the light reflection of zirconium oxide; alternatively Liner 4 may be used. In order to mix the lin- ers, IPS e.max ZirLiner Build-Up Liquid was added. The result was a mixture with a pleasing consistency that would ensure an even coating. After the firing process, the restoration exhibited a homogeneous surface and an adequate level of fluorescence. For the foundation firing of large restorations, we prefer the layering technique rather than the sprinkle technique. The layering technique provides better adhesion and optical effects (wash firing: Deep Dentin A2, A1, DA2, A1 and T-Neutral) (Fig. 10). The individual vestibular surfaces can be easily veneered.

Fig. 11: After final refinement of the framework.—Fig. 12: After the liner and foundation firing.—Fig. 13: The vestibular anterior surfaces were veneered individually.—Fig. 14: After final firing, the monolithic crowns did not appear brighter than the veneered crowns.—Fig. 15: Finished bridge: harmonious shade effects and homogenous surface texture.—Figs. 14 & 15: The cemented bridge pleases with its beautiful natural appearances and meets the patient’s functional and aesthetic expectations.

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The tooth shape was given and the framework was used as the basic shade (veneering: Dentin A2, A1, T-Neutral, OE1, OE2, I1) (Fig. 11). After the firing process was completed, the value, saturation and light reflection effects looked as desired. The shade effect of the restoration is identical in intensive light, in normal light and in the shade and matches the chosen A–D tooth shade.

Shade characterisations (Shades, Stains) are applied to the monolithic portions before dentin firing. We continued to apply thin “soft” coatings of colour and used IPS e.max Glass Fico for the glaze firing process.

After the final firing, the restoration exhibited harmonious shade effects. The bridge satisfied all functional and aesthetic criteria. The monolithic portions did not appear brighter than the veneered parts (Fig. 12). Finally, we polished the bridge and ensured that the conditions for optimum oral hygiene were in place. Smooth surfaces are essential to prevent the excellent biocompatibility of zirconium oxide from being diminished and undesirable wear from occurring in the opposing jaw. After a final check, the restoration was forwarded to the dental practice (Fig. 13).

**Conclusion**

After the preparations were completed, the bridge was cemented in place. The ceramic restoration looks three-dimensional. Even without layering, the posterior teeth demonstrated a natural colour depth. With their vibrant internal shade effects and lifelike warm translucency, the anterior teeth demonstrated impressive aesthetic properties (Fig. 14).

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**Dr Dario Žujic** is working as a dentist in Rijeka in Croatia. He can be contacted at dario@indentalestetica.hr.

**Velimir Žujic** is working as a dental technician in Rijeka in Croatia. He can be contacted at velimirzujic@yahoo.com.

**Dragan Stolica** is working as a dental technician in Maribor in Slovenia. He can be contacted at stolica.d@gmail.com.

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The combination of cutting-edge milling technology and high-quality veneering ceramics provides an efficient route to achieving aesthetically pleasing, reliable and long-lasting treatment results. The goal of the prosthetic treatment team is to see a happy patient with a beautiful natural smile (Fig. 15).