A convincing duo: Zirconium dioxide and fluorapatite glass-ceramic

The symbiosis of different procedures and materials for simplified and safe outcomes

This patient case demonstrates how a monolithic zirconium dioxide framework can ensure stability and function in a complex prosthetic restoration. The ceramic veneering of the vestibular surfaces gives the restoration natural light optical properties, contributing to the very pleasing final results.

Initial situation

A 60-year-old patient came to the dental practice as an emergency case. In addition to aesthetic and functional problems, there was severe periodontal damage. The treatment began with an in-depth diagnosis and an informative consultation. First, teeth #23, 26, 14, 16, 11 and 12 were extracted. The periodontia was then targeted. Treatment of the periodontia was successfully completed approximately 13 months later. Implants needed to be placed in regions #11–13, #14–16, #21–24 and 27, as well as in regions #25 and 26. The clinical situation meant that all teeth in the maxilla and some teeth in the mandible had to be restored.

Planning and temporisation

Before starting such an extensive prosthetic reconstruction, photographic documentation of the oral situation and the patient’s face is essential. Primarily, the photographs help in assessing the axes and planes in terms of optimum aesthetics and function. We work with a 3-D design program (Digital Smile System, DSS). This tool enables us to simulate the possible results virtually. Another advantage of this software is that the photographs can be used in the CAD software while the restoration is being produced. The teeth to be extracted were removed from the situation model, and the remaining teeth were prepared using the information provided by the dentist.

On this foundation, we designed a wax-up with the CAD software (3Shape) and then transferred it to wax. This was the basis for a matrix made from transparent silicone, which was sent to the practice. After the dental preparation was complete (implant placement, preparation, etc.), the matrix was filled with an auto-polymerising temporary composite (Telio CS C&B, Ivoclar Vivadent) and a temporary restoration was produced and then inserted into the mouth. The temporary restoration served as a dental prosthesis during the implant healing phase, and it allowed us to determine whether the situation, which was planned in the laboratory, harmonised in a functional and aesthetic manner in the patient’s mouth. The patient wore the adapted temporary restoration for approximately six months up to the osseointegration of the implants.

Production of the final dental restoration

Implant abutments

The wax-up was positioned on the master model and adapted based on the patient’s and dentist’s feedback. A double scan followed. We digitised both the model and the wax-up using the laboratory scanner. Subsequently, the implant abutments were produced via CAD/CAM. The implant abutments were milled from a new translucent zirconium dioxide material (IPS e.max ZirCAD, Ivoclar Vivadent). Before sintering, we stained the cervical areas of the frameworks. We used a liquid with a warm yellow tone for the infiltration. After sintering, the implant abutments were adhesively bonded to the titanium bases (TiBase, Straumann) with a luting composite (Multilink Hybrid Abutment, Shade H4O, Ivoclar Vivadent) specifically designed for this indication. The self-curing composite provides excellent adhesion qualities. After adhesive bonding, the abutments were integrated.

Production of the framework

The following restorations were planned for the final prosthetic restoration:

1. a bridge in regions #10–13;
2. a bridge in regions #14–16;
3. a crown on tooth #17;
4. seven single crowns on teeth #21–24 and 27, as well as in regions #25 and 26.

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Fig. 1: The situation after the implants in the maxilla had healed. All-ceramic restorations were planned.—Fig. 2: Diagnosis according to photographs in the design software.—Figs. 3a & b: The master model with the gingival mask in the articulator.—Fig. 4: The upper wax-up in the planned final situation.—Figs. 5a & b: CAD construction of the abutments.

Fig. 6: The CAD/CAM-fabricated abutments (hybrid abutments) were screwed on to the implants.—Figs. 7a & b: The CAD framework construction after the buccal areas had been cut back.
We designed the tooth shape and the occlusal morphology in full anatomical contour in the CAD software. The buccal surfaces should be built up in ceramic in order to achieve optimum aesthetics. In preparation for this, the software performed a cut-back. After the framework design, the individual elements were milled from zirconium dioxide (IPS e.max ZirCAD). The material used has interesting mechanical properties, which, among other qualities, guarantee the long-term stability of the restorations. The selected shade of LT sun offers a light chroma that matched perfectly the envisaged Shade A restorations. After milling the frameworks, we corrected the morphology slightly, paying particular attention to the interdental areas. For excellent aesthetic results, we infiltrated the frameworks with the special IPS e.max ZirCAD LT colouring liquids (Ivoclar Vivadent) before sintering.

The ceramic materials (IPS e.max Ceram) for veneering the buccal areas:

- Cervical Transpa orange-pink with Special Incisal yellow 50%
- and Transpa neutral 50% and Power Dentin A2
- Power Incisal I for greater brightness at the transition lines
- Transpa blue 50% and Opal Effect 1 50%
- Transpa orange-grey to create a contrast in the incisal areas
- Transpa orange-grey with Special Incisal yellow on the incisal edges
- Transpa neutral
- Transpa clear 50% and Opal Effect 1 50%
- Power Incisal 2

Fig. 8a & b: Colouration of the zirconium dioxide before sintering.— Fig. 9: The zirconium dioxide frameworks prepared for veneering in the buccal area.— Fig. 10: The ceramic build-up in the anterior region (IPS e.max Ceram).— Fig. 11: Prepared for the second firing. Finely detailed adjustments in the shape and morphology.— Figs. 12a & b: The finished restorations. The vestibular areas were layered individually. In the occlusal and palatal areas, the framework was designed in full anatomical contour.— Fig. 13: Natural-looking translucency with internal shade effects.

Fig. 14: The all-ceramic restorations looked very natural and vital in the mouth.
In the incisal and occlusal areas, the chroma was increased and the translucency was adapted in the appropriate areas. As only the buccal surfaces were veneered in this case, the framework volume was relatively solid. We always carry out a slow sintering procedure (9 h) in our laboratory for complex restorations, such as the reconstruction presented here. Subsequently, the surfaces of the monolithic zirconium dioxide parts were polished, paying special attention to the occlusal areas. For polishing, we used polishing cones from SHOFU or anaxdent. These cones guarantee thorough polishing so that the surface can subsequently be easily polished to a high lustre. We do not use silicone cones or discs, as they leave residues on the surface, making the application of glazing materials difficult. Areas that are difficult to access during polishing are covered with a thin glaze layer.

This was followed by a restoration try-in in the patient’s mouth. The dentist checked the occlusion and function.

Veneering
After conditioning of the framework parts to be veneered, a fluorescent liner (IPS e.max Ceram ZirLiner, Ivoclar Vivadent) was applied; this gave the restoration fluorescence from the depths in order to achieve light effects resembling that of the natural dentition. Non-fluorescent materials (e.g., pure zirconium dioxide) appear dull and dark. Since the framework was already coloured, we opted for a clear liner. This additionally enhanced the light transmission and contributed to the adhesion of the ceramic veneer to the zirconium dioxide. A classic ceramic veneering build-up was then carried out. We used a special indicator (Smile Line) to mix the ceramic powder in order to differentiate the individual materials better. The IPS e.max Ceram range includes Power materials, which provide an increased level of brightness, particularly for translucent framework materials. In this case, we decided to use the Power materials. A further advantage of the IPS e.max Ceram material is its excellent stability. The individual areas do not merge during the build-up of the ceramic veneer, allowing for the exact desired effects to be achieved. In order to achieve the correct shape, morphology and liveliness, a second firing was necessary. The restorations were then glazed and finished. We like to use the glaze material (IPS Ivocolor FLUO, Ivoclar Vivadent) in a creamy consistency.

Conclusion
In the design illustrated, only the buccal surfaces of the otherwise monolithic zirconium dioxide framework are veneered. An aesthetic and durably stable result was achieved with relatively minimal effort. The qualities of the materials are used to their full advantage. These include the excellent light optical properties of IPS e.max Ceram, in this case especially the Power materials; the high strength of zirconium dioxide; the possibility of colouring the zirconium dioxide to achieve a warmer colour effect (white zirconium dioxide is far too bright for this type of restoration, and reducing the degree of brightness would have been difficult in view of the low thickness of the veneering ceramic); and the low amount of ceramic material (this allows minimal controlled shrinkage and ensures easy handling).