Successful combination of innovative and traditional techniques

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In the past few years, CAD/CAM procedures have become the preferred method for the production of indirect restorations. Due to their use, ceramic materials can be processed in an efficient way and restorations of a reproducibly high quality are obtained. Today, various digital technologies are available for the dental practice and laboratory – from digitizing devices to different software solutions to production units. In order to ensure beautiful results with a perfect fit, it is important that all solutions which are utilized in a digital production process are compatible with and adjusted to each other. Only in this way, loss of information during data transfer is prevented and highest precision is ensured for all work steps. In addition, all components should have open interfaces for maximum flexibility of all parties involved.

If these requirements are fulfilled, there are no more obstacles for a smooth process. The user is able to enter and leave the digital workflow whenever desired and can thus employ the techniques he prefers. As shown by means of the following patient case, great results can be obtained even if conventional techniques and digital technologies are combined and different materials employed. In the present case, the CAD/CAM system of the company Zfx, including a novel intraoral scanner, corresponding software and a 5-axis milling machine were employed.

Case report

The female patient, 45 years old, came into the dental practice since she was not satisfied with her existing metal-ceramic crowns on the maxillary lateral incisors. She also asked for an aesthetic improvement of her discoloured composite restorations on the central incisors and canines in the maxilla (Figs. 1 and 2).

In order to achieve an immediate improvement for the patient, it was decided to place direct composite restorations and two temporary crowns in the first step. The dental technician, Paolo Antonelli, created two provisionals for the lateral incisors with a correct over-contouring of the apical gingiva. She also asked for an aesthetic improvement of her discoloured composite restorations on the central incisors and canines in the maxilla (Figs. 1 and 2).

In the same time, the insufficient crowns were removed (Fig. 3).
A root canal revision procedure followed: the metal posts were removed, the root canals treated, glass fibre posts placed and composite build-ups performed. Then, the natural abutment teeth were prepared with a bur. In addition, the composite restorations at the central incisors and canines were replaced and the left central incisor was bleached (Fig. 4).

After evaluation of the situation, the final restorations were planned: lithium disilicate crowns for the lateral incisors.

**Intraoral impression**
With the new intraoral scanner Zfx IntraScan (Fig. 5), two optical impressions were taken: In the first step, the teeth were scanned with the provisionals in place. A thin layer of contrasting powder was applied to enable a quick acquisition procedure and the scanner was moved over the tooth surfaces. At this, it is important to avoid quick motions and to move it carefully from the buccal side to the palatal area. When all important data was captured, the temporary restorations were removed for the second scan.

For gingiva management prior to taking a digital impression of prepared teeth, the double cord technique has proven its worth. A thin retraction cord was placed, followed by a thicker one. While waiting for the retraction cord to take its effect, the mandibular jaw was scanned. Then, the first retraction cord was removed and the maxillary teeth were captured while the second cord remained in the sulcus. After having scanned the first abutment tooth, the scanning process was interrupted, the second retraction cord removed as well and the process continued. The two scanning sections were subsequently combined by the software into a single model. Finally, a bite registration was taken by scanning the teeth in occlusion.

**Evaluation of the impression**
On the screen of the notebook which was connected with the scanner via a cable, a 3D model of the scanned situation was shown. This model is generated in real time and used to observe the scanning process during data acquisition in the patient’s mouth and for quality control after completion of data acquisition: it is easily possible to verify the perfect reproduction of the finishing lines and see if all areas have been captured correctly (Figs. 6 and 7). The model can be enlarged and checked from different sides. Only when the dentist is sure that all relevant data has been acquired the model is sent to the dental laboratory.
Virtual design and production of the crowns
The software of the intraoral scanner automatically generates an STL file which is not only compatible with software solutions of Zfx but can also be processed with components of other manufacturers. In this case, two lithium disilicate crowns were designed on the basis of the 3D model using the Zfx CAD software (Fig. 8) and produced at Zfx Italia.

When the crown copings arrived in the dental practice, they were tried in to check the marginal fit and their shape in comparison with the adjacent teeth (Fig. 9). In order to obtain a highly aesthetic result, it was decided to individualize the core crowns with ceramic layering material using the cut-back technique. Alternatively, it is possible just to stain them after crystallization. Since the patient was amazed at the natural appearance of the indirect restorations, she asked for options of obtaining a similarly beautiful result for her central incisors and canines. She finally opted for the placement of feldspar ceramic veneers.

Veneers
For this treatment, the teeth were prepared (Fig. 10) and a polyether impression was taken with the two disilicate crowns placed on the lateral incisors. The crowns remained in the impression material (Fig. 11). In the dental laboratory, it was decided to produce the four veneers using the conventional layering technique due to their thickness. Figure 12 shows the six restorations after finishing.
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**Treatment result**
All six restorations were tried in intraorally and showed a perfect fit (Fig. 13), which was confirmed on the radiographs as well (Figs 14 and 15). Directly after cementation, a highly aesthetic, natural result was obtained and the patient was satisfied (Figs. 16 and 17). Figures 18 and 19 show the result one year after the treatment.

**Summary**
The present case shows that – if compatibility of all employed components is ensured – the digital workflow is an efficient means of producing indirect restorations. However, in some situations, conventional procedures may be preferred by the dental technician. In this case, it is possible to leave the digital path and continue as desired, and even switch back to digital technologies at a later stage. The new digitizing device – Zfx IntraScan – proved to be highly precise, since the produced crowns stood out due to their excellent fit.

**Fig. 13:** Try-in of the restorations.

**Fig. 14 (right):** The perfect fit of the two crowns …

**Fig. 15 (left):** … is also visible on the final radiographs.

**Fig. 16:** The aesthetic result directly after placement …

**Fig. 17:** … of the veneers and crowns.

**Fig. 18:** Treatment result …

**Fig. 19:** … after one year.