Learning and keeping pace with change in dentistry

(Master Dental Technician Kay Amberg, Dentist Knut Amberg)

With CAD/CAM systems in dentistry users have far more possibilities today than would have been thinkable a few years ago. Whereas in the past production of crown and smaller bridge frameworks as well as inlays, onlays and veneers was the main focus, these days complex geometries can also be realised thanks to further developments of software and hardware. Now is the time for all orthodontists to get acquainted with digital technologies and continue their education to keep pace with the developments - for example dentistry without CAD/CAM is no longer imaginable.

Construction of complex restorations

For example individual abutments, implant-supported bridges and bars, attachments and much more can be constructed with the Zfx CAD software (Zfx, D-Dachau) and then manufactured in a milling centre of the company. However, satisfactory results can only be achieved if the user has sufficient experience and can ensure safe operation of the software.

Starting to work with the software and scanner is easy following respective introductory training by Zfx: Orthodontists can start to plan less complex work instantly. But they should not rest here, and instead invest in their continued professional development.

Because with their ability for example to digitally construct a telescopic prosthesis or implant-supported bridge and manufacture it computer-aided they are one step ahead of others. And those that stay up-to-date will be able to quickly use future developments to their own advantage.

An insight into the possibilities open to orthodontists today thanks to the Zfx CAD software is provided by the following patient case:

Patient case

The female patient, born in 1937, first came to the dental practice Knut Amberg in Munich as she was unhappy with the appearance of her existing restorations (fig. 1 and 2). Adding to this were functional limitations due to her telescopic restoration in the upper jaw not gripping properly. On first examination it turned out that all remaining teeth were not worth keeping. Based on her desire to have properly gripping restorations, the following therapy plan was agreed with the patient: Insertion of four implants in the upper jaw as well as restorations of individual titanium abutments and a 12-unit titanium Toronto bridge (screw-retained bridge), which should be veneered with composite. Before treating the upper jaw, five implants were already inserted in the lower jaw and a screw-retained bridge was incorporated.
**Implantation**

For the implants in the upper jaw, OsseoSpeed TX 3.5 S implants for regions 12 and 22 as well as OsseoSpeed TX 4.0 S implants (Astra Tech, D-Elz) for regions 15 and 25 were selected. First of all the initial diagnostic findings in the upper jaw were x-rayed (fig. 3). This was followed by extracting the teeth not worth retaining with the exception of the abutment teeth 13 and 23 required for stabilising the telescopic prosthesis.

The implants were integrated into the local bone in single steps. Augmentative measures were only required in region 15 and 25. With this procedure swelling could be largely avoided and there were no complications or serious limitations for the patient during the entire treatment phase. Following the protocol for early loading, first of all the implants were loaded slightly via the gingiva formers after three months of healing. The figure shows the implant in region 15 three months after insertion. During the whole 6 months of healing, the telescopic prosthesis, which was mostly gingiva-supported and stabilised by the abutment teeth, served as provisional restoration.

**Construction of individual abutments**

In order to plan the implant-supported restorations in the upper jaw, the upper jaw with the implants already fitted as well as the opposing jaw were moulded and plaster models were made. These were then digitised with the scanner Zfx Scan III (fig. 5) and the data was imported into the Zfx CAD software. Before requesting the data and starting construction, an order sheet with the patient data is always created. In the tooth diagram it is then highlighted which restorations are intended for which positions. In the present case, four anatomical caps were intended for the implants as well as reduced pontics in regions 16, 14, 13, 11, 21, 23, 24 and 26, which were then to be joined together to form a bridge (fig. 6).
Then the model of the upper jaw was opened and the virtual construction of the abutment was performed by displaying a possible tooth setup - a manually modified suggestion by the software (fig. 7).

Here the emergence profile can be designed and a suggestion by the software for the abutments can be displayed as well as individually modified. The position and shape of the abutments can be adjusted by moving edit points, furthermore, material can be applied or removed and the abutment can be smoothed with free form tools (fig. 8 and 9).

Once the model was complete, a final check was performed by displaying the completed objects in the jaw scan data with opposing jaw faded in (fig. 10). The construction data were then sent to the Zfx Munich (D-Altomünster) milling centre, where the abutments were manufactured from titanium. The fit of the sent abutments was checked on the model in the dental lab, which showed that no major postprocessing would be required (fig. 11 and 12).

**Designing the bridge framework**

To construct the framework of the Toronto bridge, the model of the upper jaw including attached abutments without gingiva mask (fig. 13) as well as the opposing jaw model were scanned in and the data was read into the CAD software. Then the fully anatomical design...
(fig. 14), which was already modified during planning of the abutment, was further processed and the occlusion was adjusted taking into consideration the opposing jaw (fig. 15). This was followed by anatomically reducing the virtual restoration by the desired layer thickness for veneering (fig. 16). For this step preset parameters that are adapted to the material of the planned restoration are available, which can be modified as desired.

The pontics were now adapted to the gingiva - the distance to the soft tissue can be determined at the same time - and the connectors were constructed (fig. 17). Values for the height and width of the connectors as well as for their cross-section can be entered manually. The result is displayed on the screen and it is highlighted in colour whether the strengths required for the respective material were adhered to (fig. 18).

In addition, with the transparent display of the fully anatomical suggestion for construction it can be checked whether the connectors jut out of the restoration and could thus adversely affect the final restoration. If required the connector type can be modified by using control points which can be modified by clicking on them. Figure 19 shows the planned screw-retained bridge in the final construction step, in which all designed elements are joined together and optimised for the milling process.
Like the abutments, the bridge framework was also made of titanium in the Zfx milling centre and then positioned on the model for checking purposes (fig. 20 and 21). Here individual screw channels were attached for additional fixing of the bridge in positions 12 and 22. The respective abutments were also equipped with screw channels.

Finally, the bite registration on the model was performed with GC Bite Compound (GC Europe, BE-Leuven), a thermoplastic material (fig. 22).

**Try-in and finishing**

Trying in the framework in the patient’s mouth including checkbite for checking the occlusal space confirmed an accurate fit (fig. 23). Finally the titanium framework was veneered with Sinfony veneering composite, colour A 3.5, (3M ESPE, D-Seefeld) in the lab, fitted and inserted into the articulator to adjust the dynamic and static occlusion (fig. 24 to 26).
Following another try-in, the restoration was cemented in the patient’s mouth and - to ensure additional stability - fixed on implants 12 and 22 with a screw M 1,4 with conical screw head (bredent, D-Senden).

The patient was extremely satisfied with the new restoration, which not only looked more aesthetic than the old one but also enabled a better chewing function and phonetics (fig. 27).

**A wide range of possibilities**

As the present patient case shows, CAD/CAM systems are also very suited today to the production of highly complex restorations, but for this, technical dental know-how combined with knowledge of digital technologies are an important prerequisite for success. If the requirements are met, highly precise restorations of reproducible quality can be built. Users are not only supported by regular training at Zfx, but also by a support team which provides reliable support at any time over the phone and via remote maintenance.

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