All-ceramics and CAD/CAM technology

The ideal combination for optimised aesthetic success in restorative dentistry

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Modern dentistry is not only concerned with oral hygiene or caries prevalence—wear from attrition, abrasion or erosion is increasingly becoming a subject of concern. These destructive oral processes are in large part attributable to stress. Stress can trigger parafunctional habits and lead to gastric reflux and low pH values in saliva. Additional factors such as bulimia and excessive consumption of soft drinks also come into play.

A 30-year-old female patient presented at our practice with pain in the posterior region. She was also dissatisfied with the aesthetic appearance of her anterior teeth (Fig. 1). Considerable erosion of tooth structure on the palatal and cervical surfaces was observed at the preliminary examination (Fig. 2). An initial interview revealed that the patient consumed large quantities of soft drinks. On the basis of the clinical findings, we concluded that the woman was suffering from stomach problems with suspected bulimia.

After careful history taking and a thorough assessment including a radiographic evaluation, we began to develop a treatment plan. The plan was to rehabilitate the entire oral cavity, to restore all teeth that had been damaged by erosion or tooth decay and to protect the existing dentition from further damage. We aimed at restoring the shape and function of the teeth by raising the vertical dimension of occlusion. Interventions involving such a high level of complexity require both a comprehensive plan outlining in detail every part of the treatment and close collaboration between dentist and dental technician. Following initial examination, an impression and bite record were taken. Porcelain imagery and DSD technology (Digital Smile Design) have proven to be highly useful in situations where the dental technician cannot gain an impression of the patient’s oral situation in person.

As provided for in the treatment plan, the dental technician fabricated a diagnostic wax-up to visualize the ideal oral situation. Wax-ups are convenient to assess the feasibility of such complex prosthetic treatments. Duplicate casts were made from the contoured wax-up and silicone matrices were created (Fig. 3). In the first step, the matrices assisted in the construction of the mock-up and, further on, in the fabrication of the baseline temporarily retainer (Fig. 5). The mock-up was completed on the basis of the wax-up. It was then used to simulate the final outcome on the patient and visualize the inclination of the occlusal plane during and after treatment.

The patient agreed to the treatment plan and we proceeded to implement the necessary surgical measures—i.e. tooth extraction and crown lengthening. It is important to consider the form identified in the wax-up when performing surgical crown lengthening (Fig. 5). Subsequently, the patient underwent periodontal treatment and root canal therapy. Additionally, all existing restorations were replaced.

The teeth were prepared in two sessions. At the first session, we prepared the teeth along the gingival margin. Impressions were taken and temporaries fabricated. Generally, temporization is essential to achieve an optimum healing result after surgical crown lengthening and tooth extraction. Since the temporaries should follow the parameters established in the wax-up, we decided to employ CAD/CAM technology for this step. The wax-up and master models were digitized using a lab scanner (Wieland Dental) and the resulting data sets superimposed using dental design software (sShape). This method allowed us to transfer the shape of the wax-up to the model that contained the tooth preparations. The virtual project is automatically converted into an STL data format and sent electronically to the program responsible for the CAM process.

In this case, the STL data were imported into the milling program of a Zenotec mini CAD/CAM unit (Wieland Dental) to manufacture temporaries from TelioCAD PMMA material (Fig. 6). Occlusal and functional adjustments were repeatedly performed over the three-month healing period (Fig. 7). After successful healing, the second stage of the preparation process

Fig. 1: Patient before treatment. Fig. 2: On examination, a substantial loss of tooth structure in the cervical and palatal region was observed. Fig. 3: Mock-up placed in the patient’s mouth. Fig. 5: Situation after surgical crown lengthening. Fig. 6: Long-term temporaries were instrumental in stabilising the vertical dimension of occlusion. Fig. 7: After long-term temporisation a bite record was taken to document the occlusal position created in the course of long-term temporisation. Fig. 8: Anterior teeth prepared for the final restoration.

Fig. 9: The master models were digitised to create the final restorations. Fig. 10: Virtual construction based on the situation created by the long-term temporaries. Fig. 11: Restorations after having been milled from pre-shaded Zenostar7 Lecionia material (Wieland Dental). Fig. 12: Molars were created in full contour. Vestibular aspects of the premolars were layered over. Fig. 13: Frontal view of the completed restorations on the model. Fig. 14: Two weeks after the restorations had been seated, we achieved an optimal situation with successful pink and white aesthetics.
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was implemented. When carrying out this step, visual aids like loupes or dental microscopes are recommended to achieve accurate results. After completion of the preparation procedure, an impression of the oral situation was taken (Fig. 8). Jaw relations were established with the help of a bite record. The jaw position was “test driven” during the healing phase when the patient was wearing the temporaries. A special procedure (cross-mounting method) enables the clinician to communicate the jaw relations to the technician without loss of information.

Creating the final restorations

We used the Zenotec CAD/CAM system and ZenoStar zirconia materials (WielandDental) to fabricate full-contour crowns and bridges for the premolar and molar region. The plan was to customize the premolar restorations with IPS e.max Ceram veneering ceramic using the layering technique. The anterior restorations were manufactured using the press technique with IPS e.max Press lithium disilicate glass-ceramics. These restorations were also customized using IPS e.max Ceram. On the other hand, the final restorations had to be manufactured in such a way that they were faithful to the parameters established in the simulation models. On the other hand, the final restorations should reproduce the shape and occlusal dimension of the temporaries, which had been consistently optimised during the long-term temporisation stage. To achieve an ideal outcome, the laboratory was provided with a range of useful data to allow the technician to mount the models on the articulator and to interchange them with one another:

- Impressions for master models
- Impressions of the temporaries after functional and occlusal adjustments
- Occlusal record
- Facebook

The master models and the models of the most recently modified temporaries were scanned and uploaded to the 3Shape software program using the “cross-mounting” method (Figs. 9 & 10). Given the level of complexity involved in this case, we preferred to mill the components first from wax to be able to assess the quality of the virtual construction in a conventional fashion. With this inexpensive method, we were able to assess the shape and function of the structures in “real life.” In the present case, we noticed that a few areas had not been properly contoured in the wax. These areas were corrected accordingly. The corrected STL data were processed in the CAM module and the data required for the milling process imported into the program of the Zenotec mini milling unit. The restoration was then milled from a pre-shaded ZenoStar zirconia disc in shade T1 (Fig. 11).

It is an advantage of this material that it is supplied in discs that are pre-shaded. Normally, framework shading requires a separate working step to apply metal-oxide-based colouring liquids either by immersion or brush-on technique prior to sintering. In pre-shaded discs, the shades are added to the zirconia powder and homogenised during the industrial production process. The result is a material that demonstrates a highly homogeneous shade. As the need for manual shading is eliminated, time savings can be gained in the fabrication of restorations, providing an additional advantage. Colour consistency is another advantage that should not be underestimated. A consistent colour is achieved, irrespective of the skills and experience of the technician. To ensure an optimum integration of the posterior restorations made of zirconia and the anterior restorations made of lithium disilicate, the vestibular areas of the premolars were layered over with a veneering ceramic (IPS e.max Ceram) (Fig. 11). We used a conventional press technique in conjunction with IPS e.max Press ingots (shade LT A1) to fabricate the anterior lithium disilicate restorations and then completed the pressed crowns individually using the cut-back technique (Fig. 13).

Seating the restorations

CAD/CAM technology was used to fabricate the posterior crowns and bridges from monolithic zirconia. The occlusal conditions established in the long-term temporaries were accurately taken into account. Prior to seating the final restorations, we checked their accuracy of fit and shade match intraorally using glycerine-based try-in pastes (Variolink Esthetic Try-In). The crowns and bridges were permanently cemented using the dual-curing, luting composite Variolink Esthetic DC. In the mandible, the veneers were luted using the light-curing varnish of the same luting composite (Variolink Esthetic LC) in a neutral colour. This luting composite is easy to apply and excess material can be effortlessly removed during the cementation process.

Two weeks after the restorations had been placed, the patient came for another visit to our practice. Pink and white aesthetics were harmoniously balanced (Figs. 14–17). This outcome was possible due to the careful adaptation of the treatment to the needs of the patient and the smooth communication between practice and laboratory.

Conclusion

Successful treatment of young patients with complex treatment needs requires a high degree of accuracy and minimally invasive preparation methods. Full-contour zirconia restorations milled using CAD/CAM strategies provide a straightforward method to achieve accurate restorations, particularly for the posterior region. The success of anterior restorations continues to depend largely on the skills of the technician and on the use of materials with optimum properties, such as the IPS e.max lithium disilicate glass-ceramics.