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The truth is three-dimensional

From the creation of the virtual mock-up to the final restoration

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A high degree of imagination is required by any dentist who strives to provide patients with bespoke restorative solutions. Before the treatment can begin, all relevant data have to be gathered, as this gives the operator an idea of the final result that can be achieved. Thus an imaginary goal is set, based on which the treatment procedure can be determined and the appropriate materials selected. This article provides a detailed description of a complex case which involved the restoration of the entire upper arch with all-ceramic crowns. It covers everything from the fabrication of the virtual prototypes to their conversion into the real restorations using an efficient procedure.

Evaluating the patient's expectations is an essential step before starting the treatment. Face-to-face conversations and photographic images provide a host of details which we can combine to form a picture of the final restoration in our mind's eye. In order to share this imaginary restoration goal with the patient and to assist him/her in the decision process, our treatment strategy usually involves the design of a digital prototype. We have found this to be a key element in the creation of outstanding, bespoke anterior restorations and crucial for a successful outcome.

Starting situation



Fig 1 By means of the digital mock-up we were able to visualize the anticipated result.

A 38-year-old female patient presented to our practice with heavily worn dentition. She suffered from the esthetic and functional problems caused by this condition

After a thorough diagnosis and an evaluation of possible treatment options, we decided to restore the entire upper arch with all-ceramic crowns. We opted for a non-invasive treatment approach, ie no tooth preparation was performed. Temporary restorations made of high-quality resin material would be worn by the patient as a transitional solution during the treatment phase.

Two-dimensional, digital mock-up

As this type of treatment is very comprehensive, timeconsuming and difficult for patients to understand, a considerable amount of time was reserved for the consultation appointment. Photos of the initial

situation, which were taken according to an established procedure in our practice, served as the basis for the discussion with the patient. The digital technology available today enables different construction options to be displayed and compared on the computer screen. Based on the imaginary goal we set ourselves, several different mock-ups were digitally designed using a special photo editing tool (Fig 1). This allowed us to visualize the anticipated result for the patient. We also used this opportunity to answer her questions and eliminate any doubts preoperatively. By choosing such a procedure, patients are involved in the planning process at an early stage, which is crucial for a positive outcome. Apart from its psychologically valuable effect, this early involvement gives patients an opportunity to express their desires and expectations so that these can be included in the digital design. However, the problem with digital mock-ups is that they are easily "overdone" and

may be difficult to convert into a real restoration later on. Even though the limitations posed by essential biological principles and the properties inherent in the material can be ignored during the design phase, they definitively need to be taken into account when the actual restoration is fabricated.

Promising the patient too much at this stage

may result in a high level of patient dissatisfaction once the restoration is in place. After a few small adjustments, the digitally designed mock-up was approved by all the persons involved in the case presented. It was used as a reference during the working steps that followed.

Temporization phase – Converting the 2-D digital mock-up into a 3-D wax-up

The digital construction was measured. Based on these measurements, a wax-up was fabricated on the model (Fig 2). This wax-up created the basis for the fabrication of the provisional restoration. We decided to use the sandwich technique with Telio® Lab resin for this purpose. This material is designed to stay in the mouth for a prolonged period of time, which is an

asset when complex restorations such as the one presented are undertaken. Moreover, temporary restorations fabricated with Telio Lab feature a homogeneous structure and are easy to polish. Due to the excellent shade match of the materials involved, the shade guide prepared for the final all-ceramic restoration (IPS e.max®) can also be used for the temporary restoration. By using materials with different levels of translucency (similar to layering ceramics), Telio restorations are imparted with the desired translucency and customized shading. Even though Telio materials and IPS e.max ceramics feature similar shade characteristics, the shade saturation of a 0.4 mm thick resin build-up is different from that of a 0.4 mm thick ceramic build-up. However, we should not forget that the provisional is only intended to stay in the mouth for a limited period of time.

Using one main shade in combination with an additional incisal shade is usually sufficient to achieve an optimum result when fabricating temporary restorations. However, in the case presented, it was essential to meet the high esthetic expectations of the patient already at the temporization stage. This represented no problem – it just meant that some extra effort had to be put into the fabrication

of the temporary. A basic mixture of materials was required to build up the crowns. Our experience has shown that a natural shade effect in combination with the desired shade saturation is best achieved with a mixture of one part Dentin material and two parts Incisal 2 material. This basic mixture was used to create the crown body. Subsequently, the restoration was cut back. Effect materials were applied and the enamel portion was rebuilt with Enamel material. For the purpose of achieving a lifelike transition, the basic mixture was diluted slightly and placed between the mamelons. To enhance this effect, an Effect material (Telio Stains orange) was applied to the respective surface areas. Low-value areas were also created with a suitable Effect material (Telio Stains white) (Fig 3). During the layering process, it is advantageous to light-cure the build-up in stages. This helps to stabilize the ceramic layers once they are placed and avoids running or bleeding. By polishing the restorations mechanically they obtained their final surface lustre (Fig 4). The moment when the restorations were incorporated was a very exciting one for us all. Had we been successful in converting our virtual goal, the digitally designed restoration (2-D), into a three-dimensional temporary? Yes, we had. Figures 5 and 6 clearly show that we



Fig 2 A wax-up was fabricated on the model based on the digital design.



Figs 3 and 4 The temporaries were fabricated with Telio Lab resin using the sandwich technique.



Figs 5 and 6 The temporary restorations in situ



Fig 7 The silicone matrix served as a guide when the digital design was converted into the real restoration.



Fig 8 The pressed crown coping

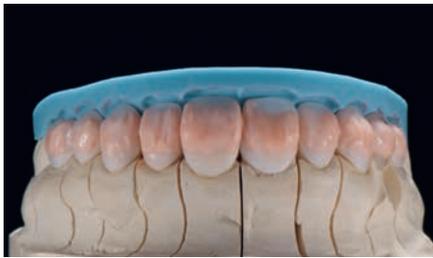


Fig 9 The crowns were layered with the help of the silicone matrix.



Fig 10 After the first firing



Fig 11 Preparations are made for the second firing cycle.

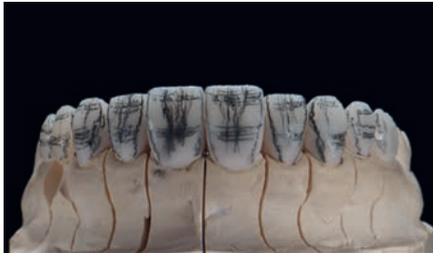


Fig 12 Surface texture was applied prior to glaze firing.



Fig 13 The crowns are ready for incorporation.



Fig 14 The frontal view of the final result proves ...

were on the right track to achieving the goal we had set ourselves. In preparation for the definitive restoration, a silicone matrix had to be fabricated based on the provisional restoration. Before that, however, occlusion, phonetics and esthetics were verified and adjusted where necessary. The silicone matrix served as the basis for the fabrication of the copings (Fig 7).

The final restoration

At this stage, the major part of the work had already been accomplished. The patient had worn the provisional restorations for a prolonged period of time and neither complained about functional nor phonetic problems, which confirmed that the preparatory work had been successful. This only left us with the task of reproducing the temporary restorations in ceramic. Since our objective was to create highly esthetic restorations, we chose to use pressed-ceramic copings in combination with a ceramic layering technique (IPS e.max). The copings were modelled in wax and pressed using IPS e.max® Press Opal 1 ingots (Fig 8). In order to achieve an optimum chameleon effect and a natural-looking result, the restorations were designed with highly translucent cervical areas. This was easy to accomplish with IPS e.max materials. However, if these materials

are used arbitrarily or incorrectly, they can absorb light, which may result in a greyish tinge. As the thickness of the pressed copings was between 0.5 and 0.6 mm, they appeared very fragile. Using the silicone matrix as a guide, IPS e.max® Ceram layering ceramic was applied to the copings.

For the first firing, a mixture of Dentin and Deep Dentin materials was applied (Figs 9 and 10). Using a sophisticated, well-practiced technique, internal characterizations were added using different Effect materials (Fig 11). Finally, the build-up was coated with a layer of Enamel material. Prior to glaze

firing, surface texture was applied to the surface of the restoration. This working step is crucial to attaining a lifelike appearance of the final result (Fig 12). After the glazing paste had been applied, glaze firing was conducted. Then the crowns were ready to be incorporated (Fig 13). This was another exciting moment. Had we succeeded in reproducing the shape, function and phonetics of the temporary restoration in the final ceramic restoration? Yes, we had. Figure 14 shows the crowns after final incorporation. The end result proves that the treatment can be considered a complete success (Fig 15).



Fig 15 ... that our efforts were crowned with success.

Conclusion

In the case presented, we succeeded in converting the virtual goal we had set ourselves into a real restoration. Our treatment strategy involved the design of a digital mock-up based on photographs of the preoperative situation. Our patient was given a say in the treatment as she was able to contribute her ideas when the restoration was digitally designed. We would like to emphasize once again that realistic digital mock-ups should be created. Limitations posed by nature or material sciences can be ignored when digitally designing the

restoration on the computer screen; however, being "overenthusiastic" at this stage can lead to problems during the realization phase. The digital mock-up was used as the basis for creating a long-term provisional via the wax-up. All the desirable functional and phonetic characteristics were already included in the provisional restorations. As the patient wore them for a fairly long period of time, they represented a reliable basis for the creation of the definitive all-ceramic restorations.



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Q1.) Evaluating the patient's expectations is an essential step prior to starting treatment. How can this be achieved?

Q2.) How is the information shared with the patient?

Q3.) How may digital mock-ups be a problem later on?

Q4.) Which technique was used to fabricate the provisional restorations?

Q5.) What technique is usually sufficient to achieve an optimum result when fabricating temporary restorations?

Q10.) What IPS e.max Ceram layering ceramic was first applied to the coping?

Q6.) Prior to the fabrication of the definitive restoration what was verified and adjusted where necessary?

Q7.) What technique was used to was used to create highly esthetic ceramic restorations?

Q8.) Why were IPS e.max Press Opal 1 ingots used?

Q9.) What was the thickness of the pressed copings?

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