

A perfect synergy of technologies - CAD/CAM materials in combination with a new luting composite

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Introduction

State-of-the-art technologies and materials provide a fast route to achieving excellent results. With careful clinical planning, the chairside part of the treatment can often be completed in a single appointment. Intraoral digital impressing circumnavigates the risk of deformed impression materials and allows preparations to be visualized in a 3D format. Three-dimensional visualization helps patients form a clear idea of what their treatment can achieve and increases the likelihood for obtaining their approval. These advantages are augmented by the favourable mechanical properties of modern ceramic materials such as lithium disilicate glass-ceramics (LS2). In a nutshell, the benefits of CAD/CAM-based manufacturing include reduced treatment times, enhanced accuracy of impressions and precise visualization of the treatment outcome. The following case report describes the clinical steps required in the fabrication of anterior single-tooth crowns to achieve functionally and esthetically first-class results.

Preoperative assessment

A female patient presented with anterior metal-ceramic restorations, wishing for an improvement of her esthetic appearance (Fig. 1). A radiographic examination was carried out followed by an intraoral photographic series. Then, the esthetic parameters were evaluated. Using the conceptual treatment planning tool Digital Smile Design (DSD, Dr C. Coachman), the desired changes were visualized on the computer and discussed with the patient. Visualization is essential in an esthetically motivated treatment that requires preparation of the tooth structure because it affords the opportunity to familiarize the patient with the most salient changes in a straightforward fashion.

After the patient had approved of the treatment, a conventional intraoral impression (polyvinyl siloxane) was taken and a diagnostic wax-up fabricated. The gum line was not altered at this stage. The diagnostic wax-up was key in helping the patient fathom the prospective three-dimensional volumetric change in her anterior dentition and fabricating the temporary restoration. Among other things, the patient's main concerns were to have the excessive length of her anterior teeth ameliorated to harmonize with the surrounding dentition and to have the severe palatal curvature mitigated.



Figure 1



Figure 2

Planning and temporization

The information gained from the DSD procedure and the try-in of the mock-up formed the basis for the final treatment planning. The mock-up model conveyed a precise impression of the morphological changes to be applied to the teeth. At the try-in, the canines were found to be too long

in relation to the new appearance of the central and lateral incisors (Fig. 2). To redress this situation, the patient was given the option to have her canines reduced by approx. 1 mm following the insertion of the temporary restoration. Furthermore, the patient was informed of the need for surgical intervention to adapt the course of her gum line.



Figure 3



Figure 4



Figure 5

Treatments necessitating a reduction of healthy tooth structure and/or a change of the gingival profile require the use of visualization software, such as the Digital Smile Design program, because such changes cannot be made visible with models or mock-ups.

After the existing restorations were removed with a tungsten carbide bur (Fig. 3), the resulting abutments were in a sub-optimal condition and tooth 22 was damaged by a carious lesion. It was therefore necessary to build up the abutments using composite material and an adhesive before the temporary PMMA restorations (polymethyl methacrylate) could be placed. The primary objective was to avoid a further reduction of tooth structure. After completion of the conservative treatment, the built-up teeth were again slightly reduced to create space in the interproximal area with the aim to encourage the papillae to grow into the interdental spaces between the temporary restorations (Fig. 4).

Surgical intervention

Surgical crown lengthening was performed to attain a harmonious gum line. After the periodontal surgical soft tissue procedure, the bucco-lingual bone was reduced using a diamond-coated drill and hand chisel with the aim to expose 5 mm of tooth structure above the alveolar bone crest. After the surgical intervention, the exposed root surfaces were smoothed up to the bone crest with the help of cures, followed by the preparation of the abutment teeth. Here, the aim was to modify the natural emergence profile of the teeth as they emerge from the alveolar ridge and, as a result, to limit the coronal growth of the soft tissue portions in the buccal and palatal areas. Finally, the soft tissue flaps were secured over the buccal and palatal sides of the alveolar bone using simple vertical mattress sutures (PGA 6/0) and anchored to the periosteum on the buccal side. After the surgery, the temporary restorations were



Figure 6



Figure 7



Figure 8



Figure 9



Figure 10



Figure 11



Figure 12



Figure 13



Figure 14

inserted using calcium hydroxide cement. This intervention meant that the patient was not able to clean her teeth in the areas affected. Instead, she was instructed to rinse with 0.12% chlorhexidine solution for one minute three times a day.

Temporization

At the following appointment, the sutures were removed and a precision impression - without placing a retraction cord - was taken. This impression was used to create a second "series" of temporary restorations amenable to relining. Three weeks after the surgery, the final preparation of the abutments was performed. The gum line was used as a reference to provide orientation in the cervical region. Early temporization was advantageous to soft-tissue conditioning. With this measure, a potential soft-tissue rebound was easier to monitor and the desired esthetic outcome could be achieved in a targeted fashion. Over the following five to six months, the temporaries were additionally modified to allow the interdental papillae to grow into an appropriate shape.

Intraoral data capturing

Six months after the surgery, the soft tissue had developed into an ideal shape (Fig. 5). Time had now come to begin with the final prosthetic stage. Only one appointment was planned for this stage. As the patient was satisfied with the morphological shape and function of the temporary restorations, the PMMA restorations were utilized as prototypes for the final crowns. Two digital impressions were required. At the first step, a digital record of the temporary restoration was created and subsequently used as a "biogeneric" model. At the second step, the abutment teeth were digitally recorded after a retraction cord had been placed. Both the temporary restorations and abutment teeth were coated with a dusting of scanning powder to facilitate optical data capturing (Figs 6 to 8). After intraoral scanning (CEREC® Bluecam, Dentsply Sirona, Germany), the data were imported into the CAD software (CEREC Software V. 4.2) and integrated into the design of the restorations. The parameters concerning the space for the luting composite and adhesive were set to 30 and 20 μm respectively and the minimum incisal ceramic was set to 1,5 mm. Additionally, digital records of the opposing jaw and bite registration were also taken.

Material

All-ceramic restorations should demonstrate natural optical properties and offer a lifelike surface texture. Simultaneously with the advancement of CAD/CAM technology, the manufacture of CAD/CAM blanks has been consistently improved. Esthetic results that look intriguingly similar to the natural dentition can now be easily achieved due to the combination of the "enamel-like" optical properties of the IPS e.max® CAD HT blocks (high translucency) and the staining technique - no individual layering is required. Lithium disilicate glass-ceramic blocks (IPS e.max CAD HT C14/A2) were the chosen material for the case described here. The blanks were processed in the CEREC milling unit (Sirona) using a Step Bur 12 and a Cylinder Pointed Bur 12S (Fig. 9).

Crown seating

After crystallization firing, the restorations were fitted on the abutment teeth and their accuracy of fit was evaluated. Minor shape adjustments were performed and the occlusal and proximal contacts adjusted (Fig. 10). Finally, customized effects were applied to the crowns using the staining technique (IPS e.max Ceram Shades) (Fig. 11). The dual-curing luting composite Variolink® Esthetic DC was selected for placing the crowns. This material is available in several shades to allow an ideal esthetic integration. Water-soluble, glycerine-based

try-in pastes provide valuable assistance in selecting the correct colour composite (Fig. 12). With these pastes, the shade effect of the all-ceramic restoration can be simulated before it is permanently cemented. The try-in pastes feature the same shade and translucency as the luting composite after it has been cured. The consistency of the try-in paste is similar to that of the luting composite. In the present case, each time the restoration was tried in with one of the coloured try-in pastes, the shade effect was measured using a colour measurement device (SpectroShade, MHT). With the five different shades Light+, Light, Neutral, Warm and Warm+, the translucency can be modified in varying degrees of percentage, ranging from brighter/whiter to darker/yellower and the darker shades can be used to change between the levels of opacity and translucency. With a translucency of approx. 10% and a relatively bright shade effect, the "Light" version was selected for the final cementation. The crowns were seated on the same day (Figs. 13 and 14).

Conclusion

In the case presented here, the combination of CAD/CAM technology, a lithium disilicate glass-ceramic and a colour-balanced luting composite enabled us to use a straightforward and efficient method to restore our patient's smile to its full attractiveness.

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