Simply more choice: Monolithic anterior crowns

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Introduction

Given their translucency and shade characteristics, modern ceramic materials such as lithium disilicate can be efficiently applied to achieve convincing prosthetic results.

There is no denying the success of all-ceramic materials (e.g. IPS e.max® CAD). As awareness of CAD/CAM and digital dental technology increases, many den- tists and dental laboratories are realizing new benefits for themselves and their patients, such as superior strength, accuracy, durability and cost-effectiveness. In-office manufacturing systems combined with modern all-ceramic materials afford dentists new opportunities to meet the needs of their patients. This case presentation describes the digital treatment planning, restoration design, milling and characterization steps to produce all-ceramic anterior crowns. The challeng- ing demands of this case were met with a streamlined approach that delivered highly accurate and esthetically pleasing results.

Clinical case description

A 42-year-old man presented with extensive demineralization and caries on his maxillary anterior teeth (Fig. 1). After the patient had been carefully diagnosed and given detailed advice, a treatment plan was established: Teeth 13 to 23 were to be restored with all-ceramic crowns. The teeth were prepared and temporarily restored with provisional crowns (Fig. 2). Ten days later, the patient was seen for a follow-up, at which time he felt generally comfortable and pleased with the esthetics of the temporary restorations. He only requested a few modifications that involved some minor recontouring and reshaping of the incisal edges and incisal embrasures.

Once these adjustments were made, the patient was completely satisfied with the appearance of his temporaries and it was therefore decided to use them for the digital "mock-up" of the final crowns (Fig. 3). A digital record of the oral situation was obtained with an intraoral scanning device (3Shape Trios® Color, 3Shape Denmark) (Fig. 4). The opposing teeth were included in the scan to enable a digital bite registration. Additionally, this was also the ideal time to determine the tooth shade with all its individual characteristics.

The temporaries were then removed, the patient was anaesthetized with local anaesthetic, and the gingival tissues were gently retracted using a retraction cord (Siltrax® Plus, Pascal International, USA), after which the preparations were refined. Since the plan was to mill lithium disilicate crowns (IPS e.max CAD), it was essential to eliminate any sharp edges or line angles from the preparations. Sharp edges could make the milling process very challenging and cause major fitting problems. The intraoral scanner was again used to digitally scan the pre- pared teeth. An interocclusal scan was obtained to enable the articulation with the opposing dentition (Fig. 5). The data files were then transferred to the 3Shape design system and opened using the DentalDesigner™ program.

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Figure 1: First left mandibular molar before endodontic retreatment.

Figure 2: First left mandibular molar radiographic image after retreatment, in the moment of consultation due to pain.

Figure 3: Mandibular incisors radiographic image. A radiolucent periapical area can be observed in the central left mandibular incisor.

Digitally designing and milling the restorations

When fabricating a CAD/CAM reconstruction that involves more than two teeth, it is helpful to use a physical model on which proximal and occlusal contacts can be verified. The Model Builder™ module of the 3Shape Design Center was used to design and order the model. The model design data were sent to Custom Milling Center (CMC, Arvada, USA) and printed out in high definition using 3D printer technology (ULTRA2 HD, envisionTEC, Germany). The max- illary and mandibular models were extraordinarily accurate and had a very smooth, gypsum-like surface finish.

The digital design of the six full-coverage crowns began while awaiting arrival of the models. First, the manufacturing parameters were set in the software to control individual preferences (thickness of the restoration, cement spacer, occlusal con- tacts, proximal contacts, drill radius). These

Figure 4: Digital scans of the temporaries (3Shape Trios Color) served as a "mock-up" of the final restoration.

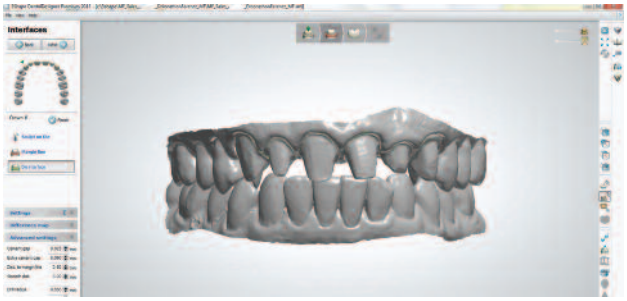

Figure 5: Scan of the prepared teeth and opposing dentition.

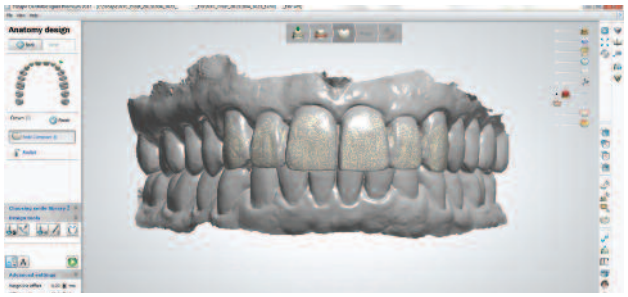

Figure 6: Colours in the design software indicate differences between the final crown design and the temporaries (proposed crown design: yellow; pre-preparation scan: grey).

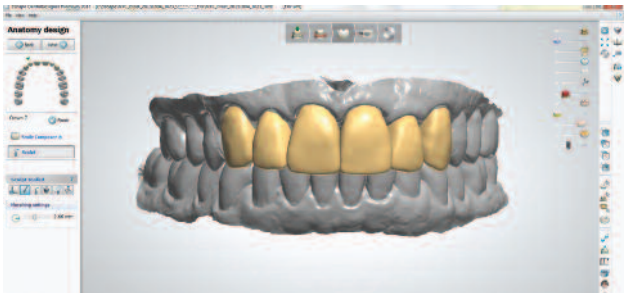

Figure 7: Final restoration design.

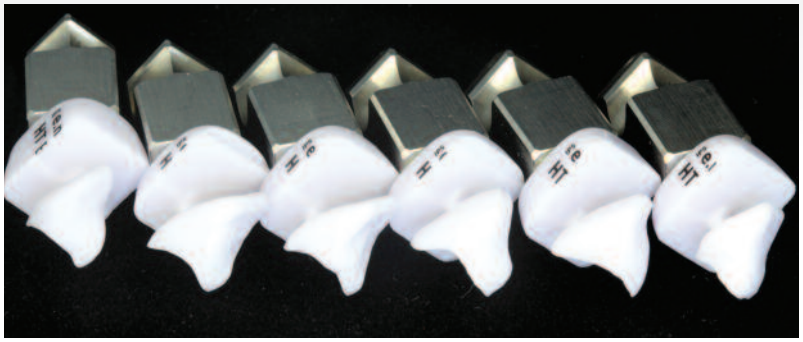

Figure 8: Milled crowns in the "blue stage" (IPS e.max CAD restorations on their spindles).

Figure 9: Printed 3D model.

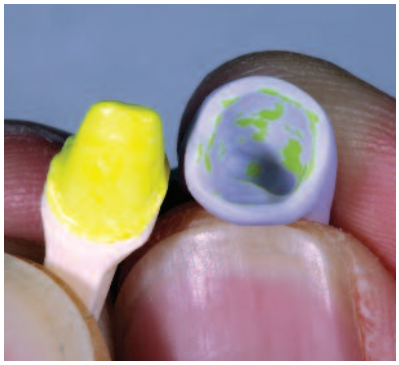

Figure 10: The fit of the crowns was checked on the dies. Minor changes may be necessary if the preparations contain sharp angles or edges

parameters may vary by individual milling machines and/or milling centres.

The scan of the temporary restorations served as a pre-preparation scan. The design software automatically morphed the proposed crown restoration into the scan of the temporaries. Generally, the crown design can be modified at this stage; however, in this case there was no need for changes. The design software uses different colours to help spot differences between the final crown design and the mock-up scan (temporary restorations) (Figs 6 and 7).

Next, attention was given to selecting the shade and translucency of the IPS e.max CAD block

In this case, the patient wanted a fairly light shade for his crowns. As his preparations were not badly discoloured, a translucent block (IPS e.max CAD HT, shade B1) was selected. IPS e.max CAD blocks for in-office milling are available in two degrees of translucency: HT = High Translucency and LT = Low Translucency. When selecting a block for monolithic crowns, using a light-coloured block with a high translucency and adding characteriza- tions with stains and shades to achieve the final shade is preferable. This technique was described in great detail by Lee Culp.[1]

The six crowns were milled using an in-office CAD/CAM unit (E4D®, E4D Technologies, USA) (Fig. 8).

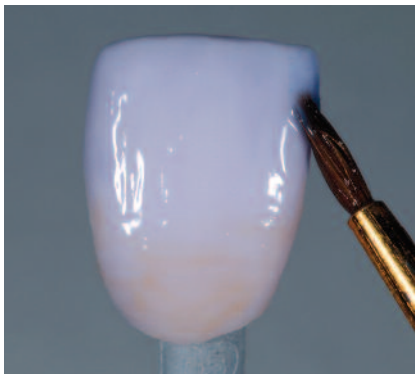

Figure 11: Here the surface texture is already established. Glazing was accomplished using IPS e.max CAD Crystall./Glaze Pastes.

Figure 12: Finishing after crystallization firing. Polishing points were used for prepolishing.

Figure 13: The finished crowns were further polished with a diamond polishing paste and a soft bristle brush.

Figure 14: Retracted view of the seated anterior maxillary monolithic crowns (IPS e.max CAD).

Refining shape and esthetics

Upon receipt of the 3D printed model, the restorations were tried for fit (Fig. 9). Milled IPS e.max CAD restorations usually fit accurately on the dies and internal adjustments are required only occasionally, especially if the teeth are pre- pared with sharp angles or edges. If this is the case, it is advisable to mill the crowns using the "detailed mode" (rather than the "standard mode"). The detailed mode utilizes thinner diamond drilling tools that are designed to reach narrow areas of the crown but take somewhat longer to mill. Milling in detail mode is preferable for all anterior restorations even if the milling process takes longer. The blue (pre-crystallized) crowns were seated on their respective dies and checked on the articulated printed models (Fig. 10).

Coloured markings applied on the labial surface of the crown to indicate the desired surface texture (perikymata, marginal ridges, etc.) provided valuable help when finishing the crowns. A series of diamond burs was then used to achieve the desired surface characteristics. After verifying the proximal contacts and occlusion one more time, the crowns were prepared for crystallization firing. This process was combined with staining and glazing using glaze and shade pastes (IPS e.max CAD Crystall./Glaze and Shade Pastes) in the gingival and incisal area (Fig. 11). Intensive colour characterizations were achieved using IPS e.max CAD Stain Pastes, a process that frequently requires multiple firings.

The crowns were polished using fine polishing points (Dialite® LD Polishing Points, Brasseler, USA) (Fig. 12) followed by a soft bristle brush and diamond paste (Pasta Grigia, anaxdent GmbH, Germany) (Fig. 13). The monolithic crowns were now ready for try-in on the patient

Seating

Proximal contacts, marginal fit and occlusion – all aspects were meticulously assessed and found to be excellent. The young man was delighted with the esthetic result. Final cementation was performed using a resin-reinforced glass ionomer cement (Fuji Plus, GC America, USA) (Fig. 14).

Conclusion

Digital dental technologies make it possible to deliver esthetically pleasing monolithic restorations even in the anterior region. In the case presented here, the shape, fit and esthetics completely met the patient's expectation

By digitally "cloning" the temporary restorations, carefully selecting the ideal shade of the CAD lithium disilicate blocks and then staining and glazing the milled restoration, the dental team was able to undertake a streamlined fabri- cation process and deliver optimum results.

Literature:

1. Culp L. Personal communication, 2013.

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