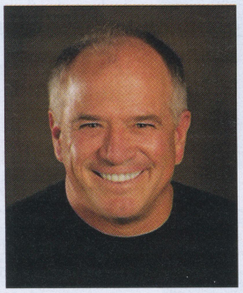
Digital Design: Predictability, Profitability, and Efficiency



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INTRODUCTION

How do we, as clinicians, meet the challenge to continually maintain competence in a constantly changing technological environment? How do we leverage new technologies to simultaneously improve the predictability of successful patient outcomes and increase profitability? When do we recognize that a technology-driven protocol offers enough improvement to justify the initial increased cost and learning curve necessary to adopt that procedure into a practice?

Digital Smile Design (DSD) is a technological breakthrough that can improve patient and laboratory communication, increase case acceptance, and provide a more predictable protocol for a successful cosmetic outcome. However, DSD is not simple and requires collaboration with a master ceramist for the vision to be brought to life. The ceramist also must have digital fabrication workflows in place.

This author admits to not being technologically savvy, yet has successfully incorporated these techniques into daily practice. This case report will serve to explain state-of-the-art real-time digital design, linking 3-D prosthetic planning with fundamental principles. In addition, this article will present proven communication techniques and outline the specific procedural steps, from diagnosis to wax-up to the final fabrication and delivery of the completed ceramics.

CASE REPORT

Diagnosis and Treatment Planning

A 34-year-old female patient presented for a functional and aesthetic assessment of her dental condition. She received a comprehensive exam, full-mouth series of radiographs, and a periodontal evaluation and diagnostic photos. Her medical history indicated that she had esophageal reflux, which was controlled with an over-the-counter medication. A clinical evaluation revealed a canted and gummy smile, with her right vermillion border being more apical than that on her left with a full smile. Her teeth were yellow, rotated, eroded, and chipped (Figure 1). Many teeth exhibited cupping (Figure 2), indicating that the erosive component was outpacing the frictional damage. She presented with a deep bite, a hypermobile lip, and a vertical maxillary excess.

A treatment plan that included orthodontics and orthognathic surgery was presented. This was refused by the patient as she was seeking a simpler, quick solution to her situation. Since the gingival levels needed to be equalized in order to attain harmony, she was referred to the periodontist, and crown lengthening was planned. A digital design for a surgical template was fabricated from polymethyl methacrylate (PMMA) to guide this surgery, and a wax-up for the provisional composite prototypes was created. Records, including a face-bow and bite sticks, were taken for communication to the ceramist.

Digital Smile Design

The ceramist uses a natural smile photo and identifies landmarks on the photo and correlates this with the same landmarks on the digital design. It is critical that the photo is taken with the patient looking straight into the camera lens with a big smile, allowing the best evaluation of facial landmarks (Figure 3). Custom templates of tooth libraries that have various shapes and styles are then evaluated. Using Keynote software, they are placed over the preoperative smile. Adjustment and fine-tuning by the user (ie, the ceramist) occurs until initial design for treatment communication in 2 dimensions is completed. This has been considered state of the art for many years (Figure 4). With the integration of full 3-D digital designs, using software programs (such as the 3Shape Dental System), these 2-D images can be entered as overlays into the actual 3-D design. The translucency of the design can be turned up or turned off (Figure 5). This allows analysis of the relationship between the design proposal and the original preoperative condition.

Figure 1. Canted, gummy smile with vertical maxillary excess; yellow, worn, and rotated teeth.

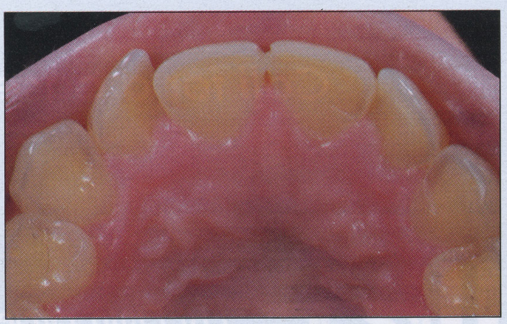

Figure 2. The cupping observed demonstrated that the chemical component was outpacing frictional damage.

This case clearly showed the areas that needed to be crown lengthened during the periodontal surgery (Figure 6). Moving these digital prototypes into the full-face photo using the same landmarks executes a virtual try-in (Figure 7). The ceramist and the dentist can communicate via email or TeamViewer in real time. Once agreement has been reached, the PMMA overlays are milled and fit to the model. Contours and surface morphology can be refined by hand at this point. It is also possible to mill the same file out of a white wax and glue it to a second model as a diagnostic wax-up. The milled PMMAs can be used as an aesthetic preview to help visualize what would be possible with complete treatment. They can also be used as a template to guide the periodontist in the crown lengthening procedure. It is important to note that this design is done prior to surgery, so after the gingival remodeling of periodontal surgery has been completed, the milled wax-up would need to be fit to a new model exhibiting the final gingival position (Figure 8). This can be done by hand, with milled wax from the previous design, or a new diagnostic wax-up can be completed post-surgery.

Preoperative Try-In

The accuracy of the digital design technique was evaluated and verified by placing the templates over the facial of teeth Nos. 4 to 13. When the template was positioned correctly, it was noted that tooth No. 11 extended apically beyond the template. Crown lengthening on tooth No. 6 was the treatment

continued on page 124