Introduction

This article presents a clear example of the increasing importance of new technologies and, more specifically, digital technologies in dental prosthesis planning and fabrication. By presenting a real case, this article aims to provide an overview of the benefits arising from the use of a new protocol in this field. The entire process of total maxillary rehabilitation with a Toronto Bridge will be presented, giving attention to 3-D scanning technologies, smile design software and CAD system. The article concludes that digital technologies are being increasingly implemented in the everyday work of both dentists and dental technicians because they provide more precise working protocols.

Total maxillary rehabilitation with a Toronto Bridge

New technologies allow conventional steps to be performed digitally. In this way, we can achieve a more efficient workflow, which saves time and costs.

The first step of the digital dentistry workflow is evaluation of the clinical situation. In particular, for relevant rehabilitations, our protocol starts with patient image management. With just two photographs of the patient, a photograph of his or her smiling face and an intra-oral photograph, we can easily create a clinical, functional and aesthetic design of the smile using an innovative software program called Digital Smile System (DSS).
Through a guided workflow, the software allows the user to quickly create a custom aesthetic test of the virtual smile, contextualizing it against the entire face of the patient, with a self-managed digital elaboration.

Owing to the eyewear marker, DSS is able to automatically align the two images and to guide the design. This particular calibration system permits users to study the morphology of the patient’s face and to acquire very reliable measures in order to facilitate the work of both the dentist and the technician (Figs. 1–3).

The mathematically controlled algorithms of the prosthetic tool for edentulous patients allow DSS to suggest the most suitable commercial dental library to be used (Figs. 4–7).

In this first phase, digital dentistry and, more specifically, the clinical use of DSS represents an incredible advantage for the planning of both the work and the information flow. Indeed, it will be easier for the dentist to present the final prosthetic result to the patient (Figs. 8 & 9a & b) and to provide the necessary information to the dental technician for fabrication of the prosthesis.

After completing the pre-visualization, the dental arch was prepared for transfer to the CAD system. Owing to direct integration with Dental-CAD (EGS), DSS can automatically export compatible 3-D output to support modelling in the CAD environment (Figs. 10–13).

Once the aesthetics have been defined, the workflow moves to acquisition of the 3-D data
First, we used a desk scanner with blue structured light technology (DScan3 Blue Light, EGS) to acquire data from the model. This provided very accurate data (up to 15 μ) to the laboratory for an effective and efficient result (Fig. 14).

We then used a body scanner to acquire the facial data with great precision (Fig. 15). This scanning step was fundamental for the volume construction and for the consequent fabrication of the underlying framework (Fig. 16).

At this point, all of the data collected was transferred to DentalCAD, now in Version 4.2. We then created the framework using its simple 3-D modelling tools and by importing the volumes studied in DSS (third step of the digital dentistry workflow). Using the 3-D data of both the face and the mouth, we were able to study the occlusal aspects, as well as the relationship between the teeth and lips. It was possible to align the 3-D scan of the face with the 3-D scan of the mouth owing to an additional scan taken with an extra-oral landmark (Figs. 17–22).

The very high quality of the mesh created with DentalCAD allows 3-D printing of the framework in PMMA in order to try it on the patient. In accordance with the procedure, all of the customizations necessary for the fabrication of the final prosthesis were performed in a very short period by screwing the prototype directly into the oral cavity of the patient (Fig. 23).

The use of these technologies offers several benefits, in particular, the repeatability of the shapes designed and the prototype creation. The prototype obtained can be considered definitive and fabrication of the definitive prosthesis will be simplified, since the project files will be stored digitally. In addition, the patient is shown a concrete
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pre-visualization using the prototype (Fig. 24). The prototype is also very important for the dentist in order to check the relationship between the teeth and lips (in terms of aesthetics, phonetics and support of the soft tissue).

After this step, according to the volumes obtained, the framework to support the acrylic teeth was constructed in DentalCAD (Figs. 25a & b). Our goal was to create a framework in titanium by reducing the prototype on which the teeth were to be placed—exactly as planned in DSS. We created and submitted the CAM file for order processing through software integrated into DentalCAD.

After the milling cycle (fourth step of the digital dentistry workflow), the product was carefully adapted to the model in order to finalize the work. In particular, the titanium framework was prepared and the acrylic teeth positioned using a verticulator (Fig. 26).

By means of these new digital technologies, the dental technician is given the opportunity to express and enhance his or her skills and creativity by focusing on finalization of the aesthetics and functionality.

As can be seen, the final result is perfectly in accordance with the schedule established with the patient during the first step of the digital dentistry workflow (Figs. 27 & 28).

Following a precise workflow, the protocol covers all stages of the project, from the material choice to the production and finalization, aiding the work of both the dentist and dental technician and providing several new benefits to the patient too.

**Conclusion**

This article clearly demonstrates the precise working protocols provided by digital technologies and the reason they are being increasingly implemented in daily work in dental practices and laboratories. In particular, it has shown how the use of 3-D scanners and dedicated software is becoming part of the digital workflow in dentistry. It allows a complete aesthetic and functional preview of the final result and facilitates working in CAD with very accurate data. The digital dentistry workflow presented with this particular example has shown that the benefits arising are not limited to the work (a time and cost saving, as well as more accurate results), but also extend to the patient, who is given a reliable preview of the treatment outcome.

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