CLINICAL CASE

A Fully Digital Workflow for All-on-4™ Treatment of Complete Edentulism Featuring the DEXIS Imprevo Intraoral Scanner

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Dr. Mathieu Rousset earned his Doctorate in Dental Surgery in 2006, followed by advanced certifications in Biomaterials (2007) and Oral Surgery (2008). In 2014, he completed the European Inter-University Diploma in Oral Implantology at the University of Corte, after which he dedicated his clinical practice exclusively to implantology.

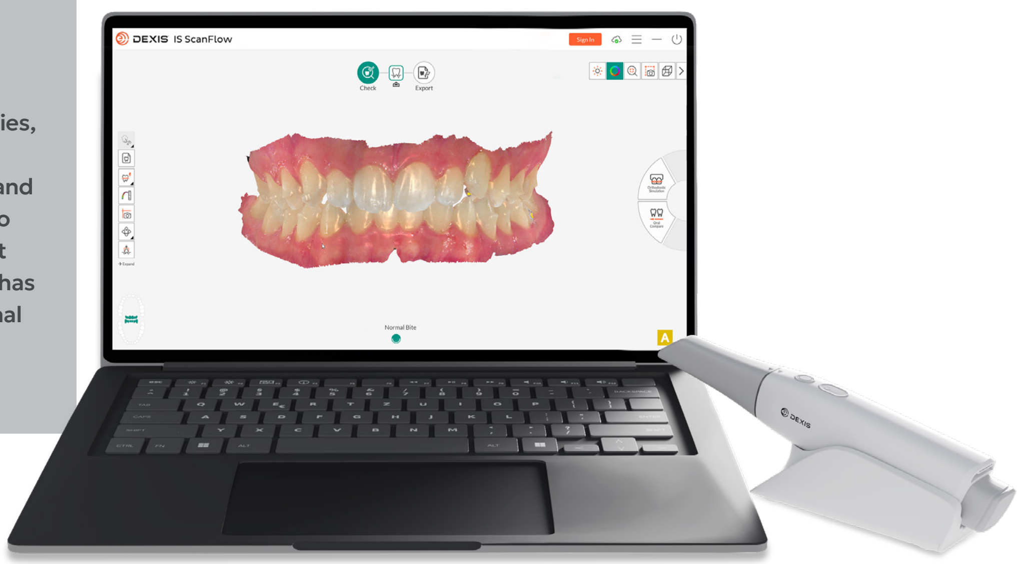
In 2015, Dr. Rousset further specialized in Computer-Assisted Dentistry at the University of Toulouse. He is the founder of AMPIO, a training center within his practice focused on guided surgery and digital workflows in dentistry.

As a key opinion leader for several international dental technology companies, Dr. Rousset actively contributes to the development of innovative digital tools and the evolution of implant systems. He also serves as a lecturer in Digital Dentistry at the DIUE in Implantology in Corsica and has authored multiple articles in both national and international dental journals.

Introduction

The treatment of complete edentulism represents a major challenge in dentistry, both technically and humanly.
The All-on-4™ method, which restores masticatory function and dental aesthetics using four implants to support a fixed prosthesis, has emerged as an effective solution. However, the success of this approach relies on the integration of modern technologies, particularly 3D printing. The use of digital technology in planning, creating surgical guides, and producing the final prosthesis allows for predictability.

This article examines the digital workflow for treating complete edentulism, focusing on the innovations that facilitate each step of the process.



DEXIS

A. The Importance of Optical Impressions

Optical impressions are the initial step in the digital workflow for dental procedures. They capture the patient's oral morphology accurately, aiding in the creation of wax-ups and surgical guides for precise implant positioning. The digital file from the intraoral scanner (IOS) is matched with the DICOM file from the CBCT scan. For full arch rehabilitation, a laboratory technician creates the wax-up, and implants and pins are positioned according to the prosthetic plan. This process involves close collaboration with the prosthetist (Laboratory Genesis - Bordeaux - France).

While optical impressions offer advantages like reduced impression time and the ability to reuse pre-surgical impressions, they need to be combined with photogrammetry for high accuracy in full arch rehabilitation on implants. This combination ensures the passivity of impressions for complete implant-supported bridges. Photogrammetry: Photogrammetry captures the position and orientation of implant interfaces more precisely than traditional intraoral impressions. It provides a simple and fast acquisition process, combining precision and accuracy. The software matches standard scanbodies with Imetric Icambody, integrating soft tissue and occlusion data from optical impressions with implant position data from Icam4D (Imetric – Switzerland).

B. Contribution of Guided Surgery

Clinical studies and recent research highlight the effectiveness of digital tools in implantology, particularly for optimizing implant placements in relation to prosthetic design. Successful use of these techniques requires close collaboration between the practitioner and prosthetist, similar to conventional methods.

Pre-implant planning and guided surgery help determine if the bone volume is sufficient at the implant site and position the implant in alignment with the prosthetic plan. Tissue deficiencies can be detected, and solutions like Guided Bone Regeneration or short implants may be used. Guided surgery, with stackable guides, allows multiple steps to be performed in one session, reducing patient stress and intervention time. However, these protocols are not suitable for everyone. The design of the guide is crucial and requires collaboration between the prosthetist and practitioner. Sintered metal guides are used for greater rigidity and stability, and the guide is spaced from the mucosa to facilitate flap creation.

C. Contribution of 3D Printing:

- Speed and Efficiency: The chairside printing of the provisional bridge is completed in less than two hours using the SprintRay Pro2 3D printer and special resin, which offers superior mechanical strength.
- Printing Process: The provisional bridge is printed in less than 25 minutes, followed by cleaning and UV post-treatment in under 20 minutes. This rapid production reduces patient waiting time and eliminates the need for a Ti base, saving time.
- Properties of the Resin: The nanoceramic resin used offers exceptional mechanical and aesthetic properties.

3D printing significantly enhances the treatment of complete edentulism with the All-on-4™ implant solution. It streamlines the workflow, reduces intervention time, and improves the quality of care. By integrating advanced technologies like guided surgery and 3D printing, practitioners can offer custom solutions, transforming the dental experience for patients. This approach represents both a technological advancement and a step towards a more efficient and humane future in dentistry.

3D printing is a real asset in the treatment of complete edentulism thanks to the All-on-4™ implant solution. It facilitates the workflow, reduces intervention time, and improves the quality of care. By integrating digital advanced technologies such as guided surgery and 3D printing, practitioners can offer custom solutions, transforming the dental experience for patients. This integrated approach is not only a technological advancement but also a step towards a more efficient and humane future in dentistry.

The presented case will illustrate the entire digital workflow: data acquisition (IOS, CBCT), wax up modeling, stackable guide creation, up to the impression for the final prosthesis validated by the use of photogrammetry. This 63-year-old patient presents a maxillary arch (Figure 1a) with numerous problems: fractured roots, unsuitable fixed prostheses causing recurrent decementation. The complexity of such cases is to preserve as many elements as possible to facilitate the creation of the final prosthesis.
We decided to extract all remaining teeth and place 4 implants post-extraction with immediate loading using a stackable guide system.

Figure 1a

Data Acquisition

An optical impression using DEXIS Imprevo (Figure 1b) enables the acquisition of an STL file of dental and gingival tissues, as well as the occlusion.

A CBCT is performed to obtain the DICOM file of the bone structures. The IOS and DICOM files are planned in DTX Studio™ Clinic and shared with the lab (Genesis Bordeaux).
In DTX Studio Clinic, virtual extractions and automatic wax-ups through AI can be completed within seconds. This marks the initial step in implant placement, and the planning is then shared with the laboratory to create another wax-up that will be utilized throughout the treatment plan.

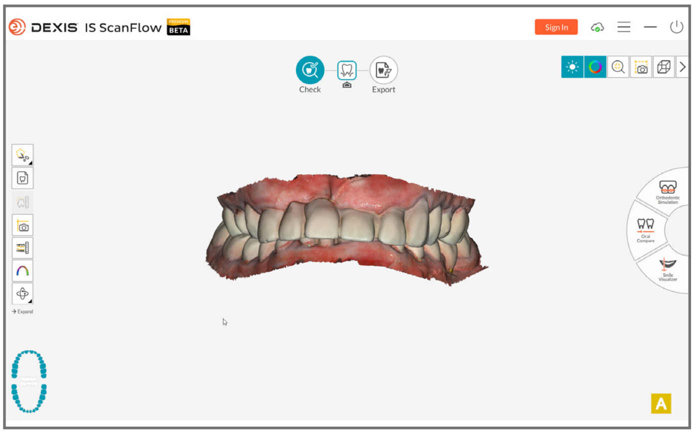


Figure 1b

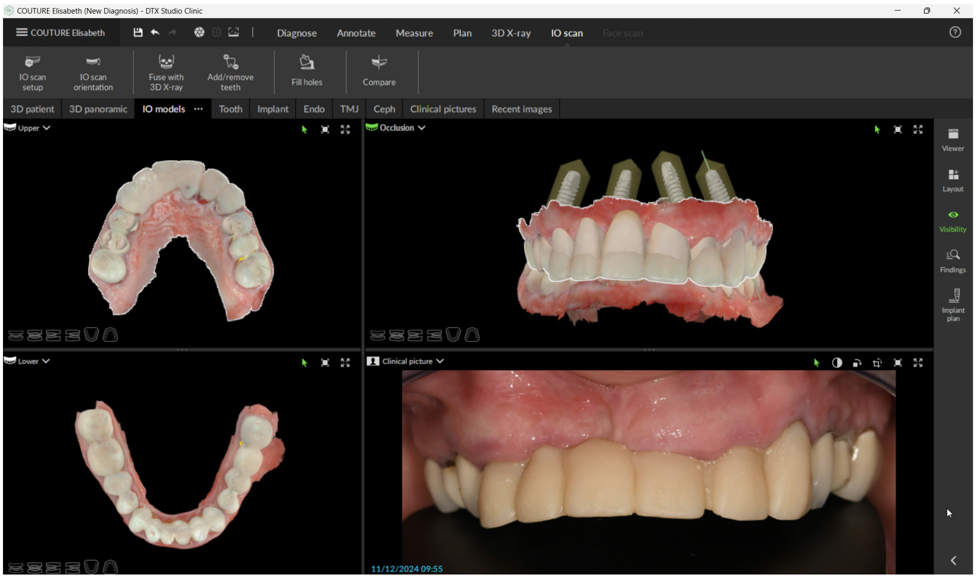


Figure 1c

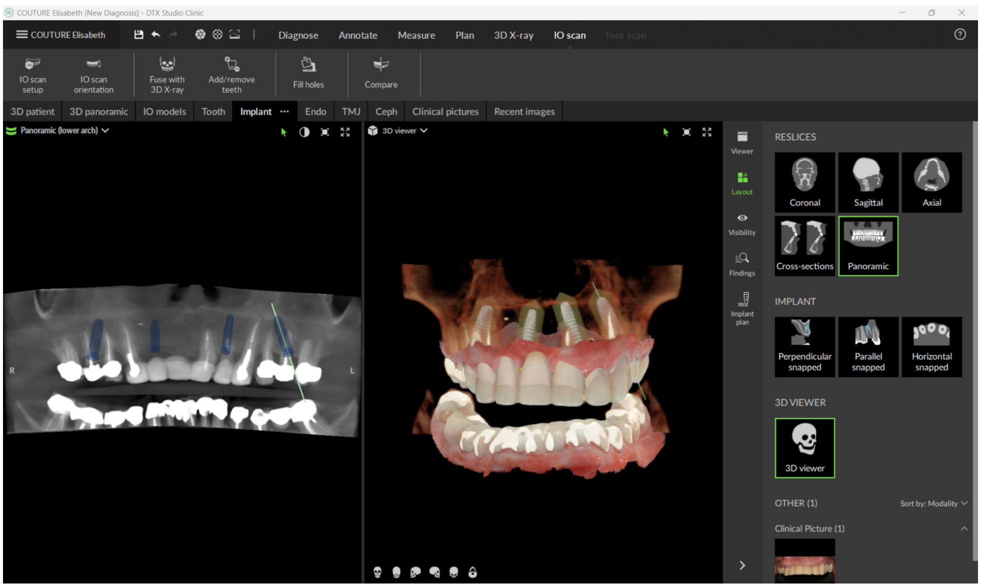


Figure 1d

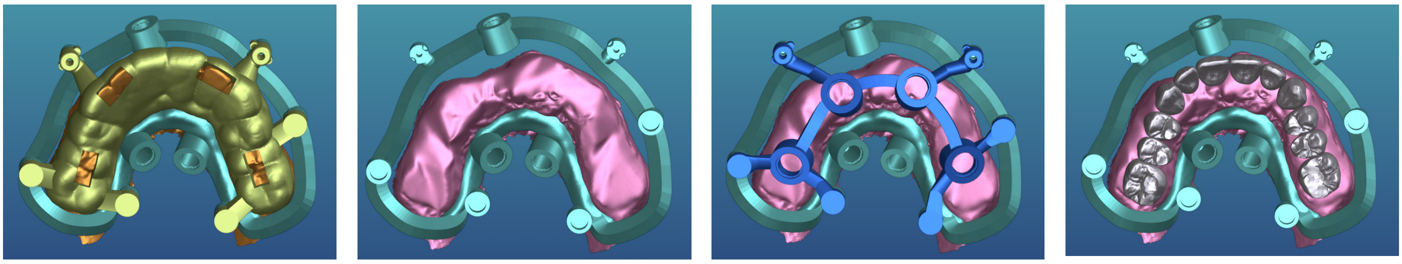


Figure 2

This wax-up will be integrated into the 3rd party software to create in that case the stackable guide and to find the best compromise between implant placement and the emergence of future screw holes (importance of managing the angulation of the abutments) to have a mechanically balanced and hygienic prosthesis.

Once the 4 implants are positioned in the software, the position of the anchor sleeves and drilling sleeves is exported to the same reference frame in third-party software (here Blender), and the design of the stackable guides can then be created (Figure 2). This design must consider the planned surgical procedures. The shape of the guide and the position of the pins must not hinder the surgeon in retracting the flaps, extracting the roots, etc. For this type of case, we use two types of materials: metal guides, offering great rigidity but expensive and long to produce. The different stages are screwed together for the same reason of stability.

The base guide (Figure 3a) is positioned using the positioning guide (Figure 3b). Once the 3 pins are in place to stabilize it, the teeth are extracted (Figure 3c). This phase is delicate with the guide in place; it is necessary to try to preserve the vestibular bone tables. Once the teeth are extracted, the drilling guide is screwed on (Figure 3d). The Thommen Medical system has a guided surgery kit that goes up to the implant placement through the sleeves.

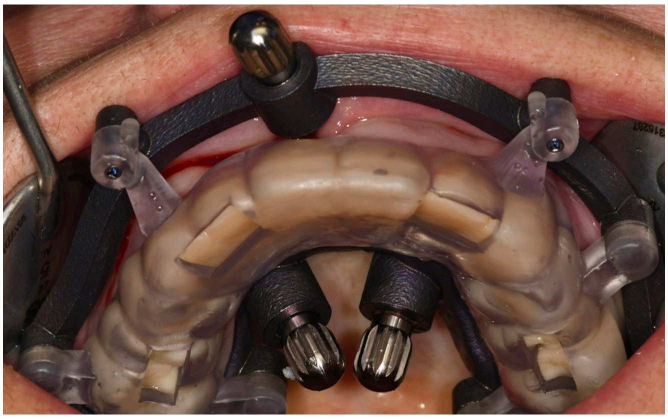


Figure 3a

Figure 3b

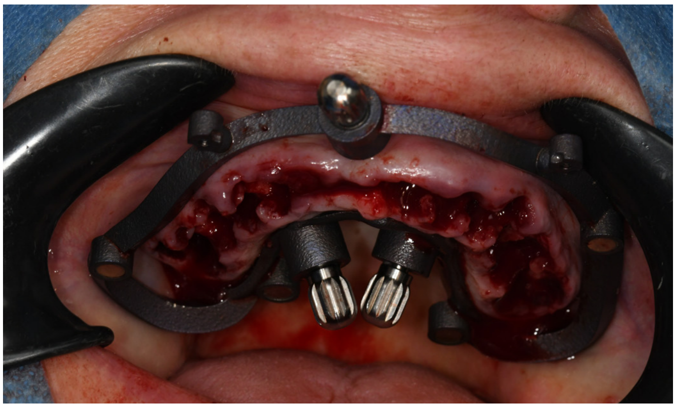


Figure 3c

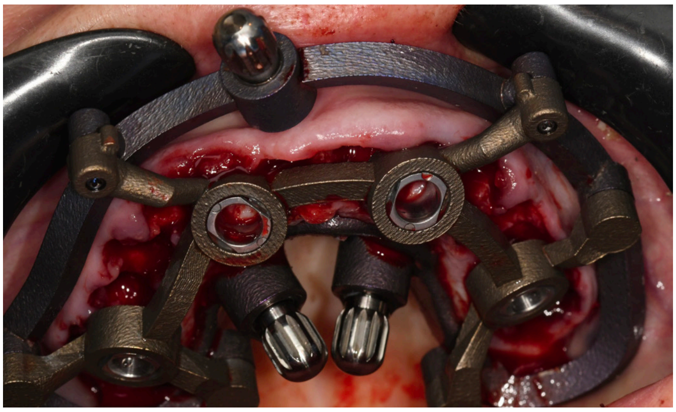


Figure 3d

The variomulti abutments are immediately screwed onto the implants. The specific scanbodies for the variomulti (Figure 3e) are put in place. We perform guided bone regenerations around the implants using stickybone made with bovine hydroxyapatite (Ti Os, G-TEC 3) mixed with PRF. Sutures are made around the scanbodies. This protocol avoids placing non-sterile products around the implants (resin, impression materials, etc.).

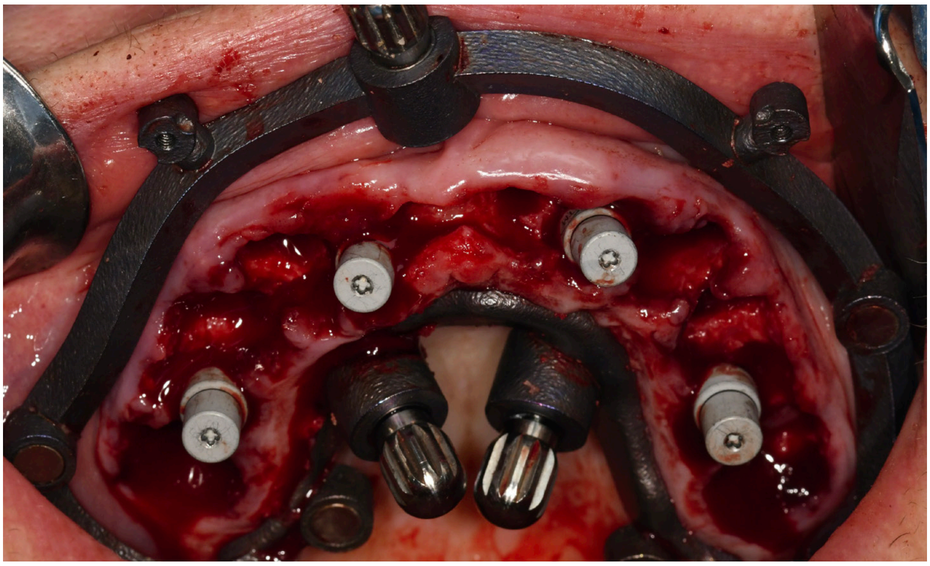


Figure 3e

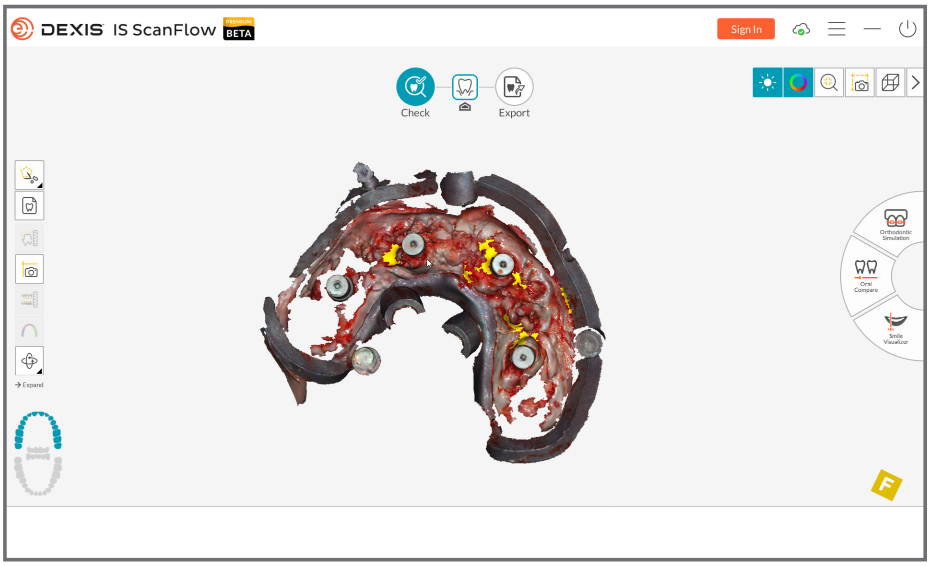


Figure 3f

An optical impression (Figure 3f) is made with the base guide in place using AI Matching mode from IS ScanFlow allowed the scanner to scan the arch even right after the surgery. This base guide, which was used throughout the surgery, will allow the prosthetist to reposition the maxilla in the three planes of space by merging it with the initial planning. The data is sent to the prosthetic laboratory (Genesis – Bordeaux - France) in combination with the data from the photogrammetry system ICam4D (Imetric - Switzerland).

Photogrammetry (Figure 3g) is an exceptional technology for measuring the position and orientation of an implant interface. It is very fast and allows obtaining an impression combining precision and accuracy. The software will match the Thommen Medical Scanbodies acquired by DEXIS Imprevo with the Imetric Icambody. The soft tissues and occlusion will come from the IOS, while the position of the implants will come from Icam4D. The lab technician will then merge the two files and superimpose them on the wax-up.

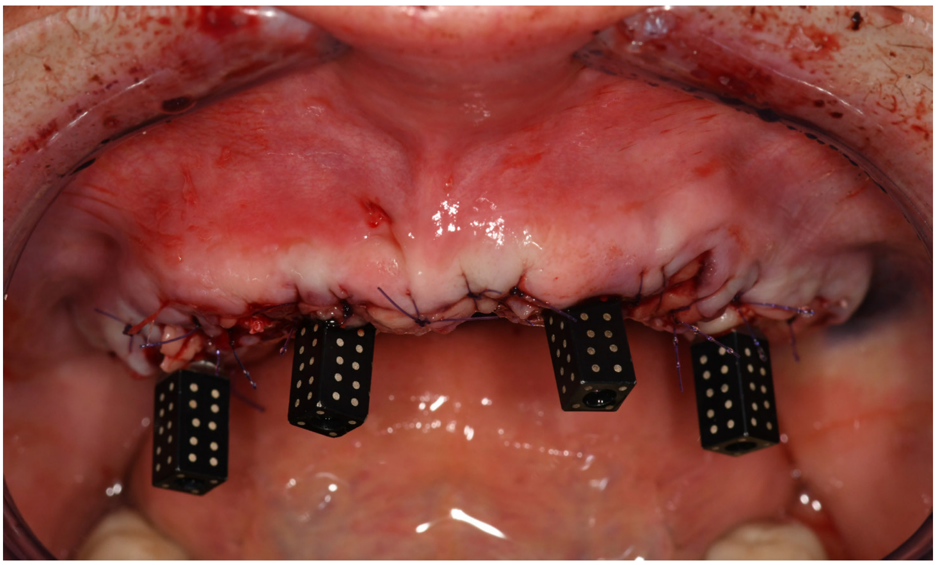


Figure 3g

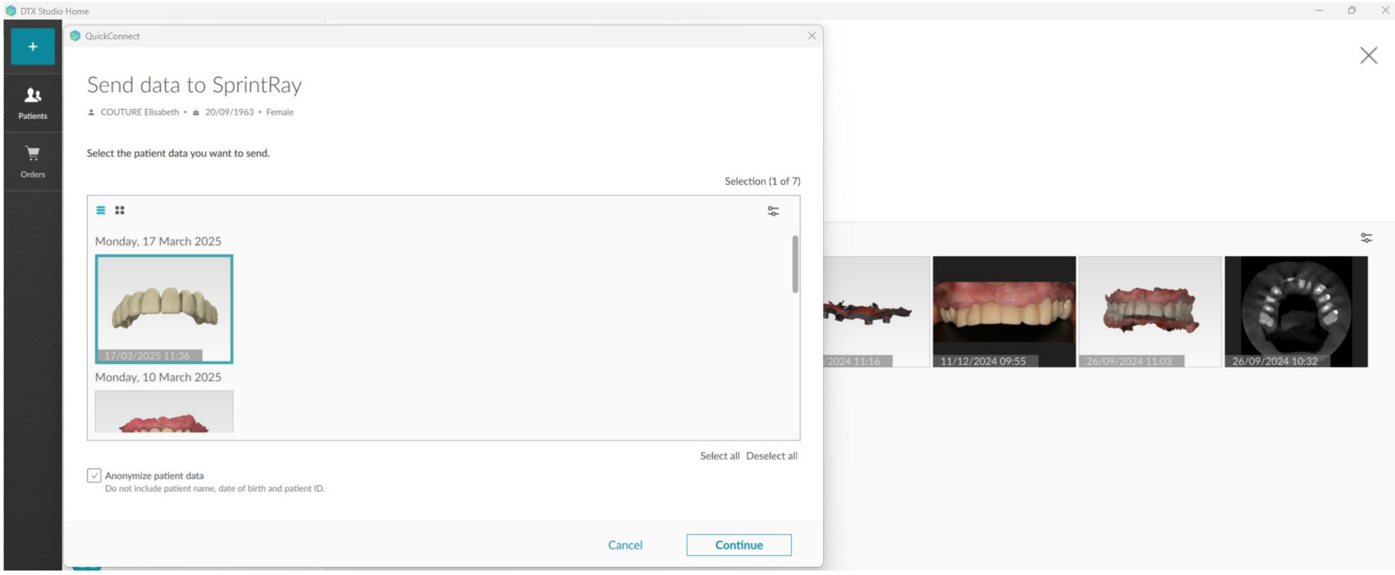


Figure 4a-1

After about thirty minutes of work, the dental technician transfers the STL file of the provisional bridge directly on Sprintray Cloud (Figure 4a).

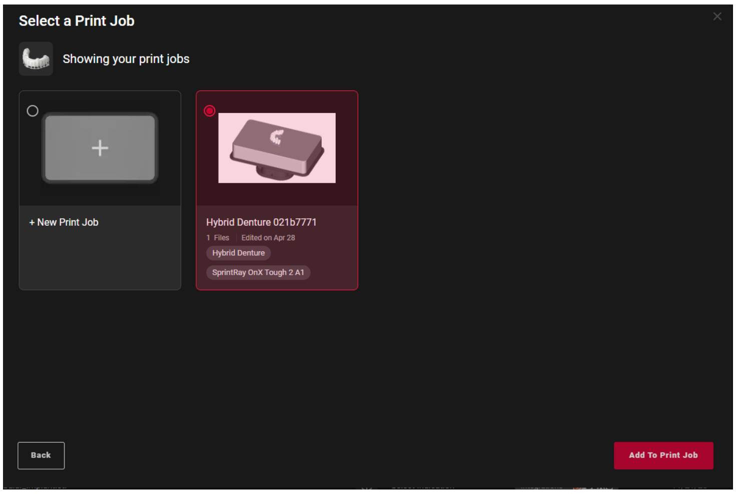


Figure 4a-2-

Figure 4b

The bridge will be printed in the office using a SprintRay Pro2 3D printer (Figure 4b). The printing takes about 25 minutes, and the same time is needed for post-treatment (rinsing with isopropyl alcohol and UV curing) and makeup (Figure 4d).

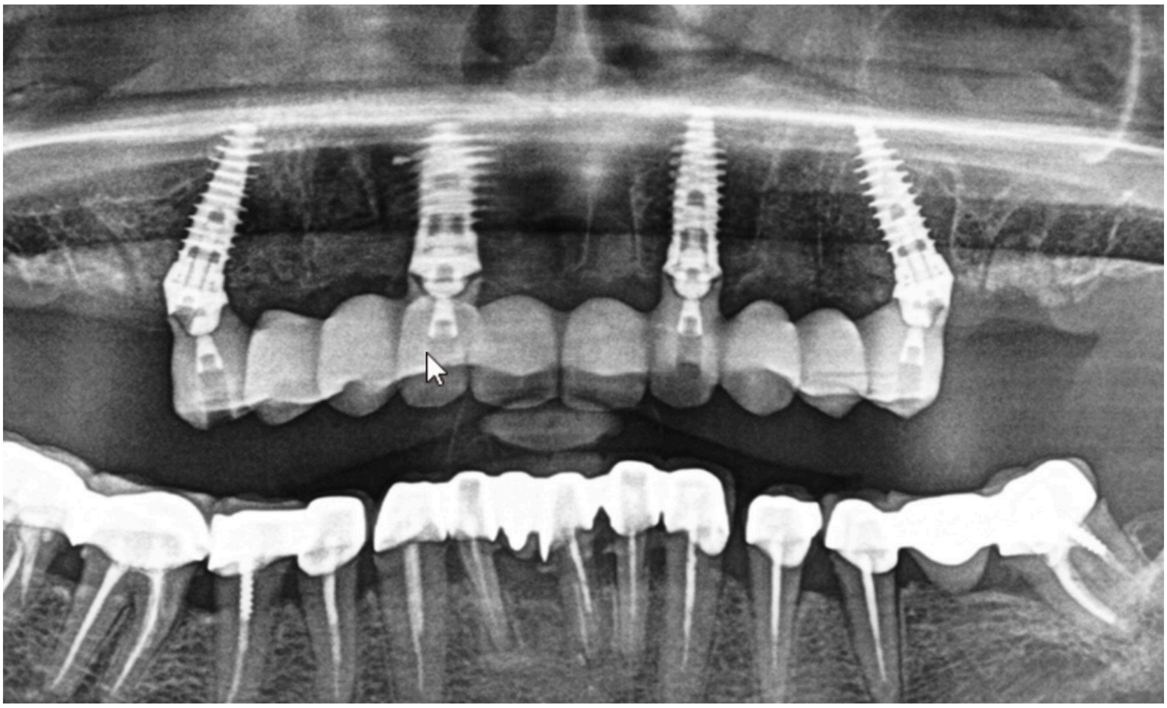


Figure 4c

Figure 4d

In less than 2 hours, a postoperative X-ray allows seeing the adaptation of the provisional prosthesis (Figure 4c), which can be screwed in the mouth (Figure 4d) using specific screws (Rosen Screw). We do not use a Ti base, so there is no bonding, which simplifies the prosthetic phase. The bridge created does not use a Ti base, which avoids the bonding step and saves time. The shape of these Rosen screws better distributes the forces within the material, potentially reducing fracture complications, with a reported frequency in the literature of about 20% . A panoramic X-ray (Figure 7e) is performed after the bridge placement. Postoperative instructions are given to the patient: soft diet for 6 weeks, clinical check-up 10 days postoperatively.

3D Printing Process

3D printing process begins by uploading a digital design file to the RayWare software (Figure 5,6), where it is prepared for printing. Next, the digital file is sent to a SprintRay printer (Figure 6a), which uses DLP technology to cure liquid resin layer by layer to build the object (Figure 6b). After printing, the object undergoes post-processing, which involves washing the part to remove excess resin using isopropyl alcohol and then post-curing it under UV light to achieve maximum strength. Finally, supports are removed (Figure 6c), and the object is ready for its intended use (Figure 6d)

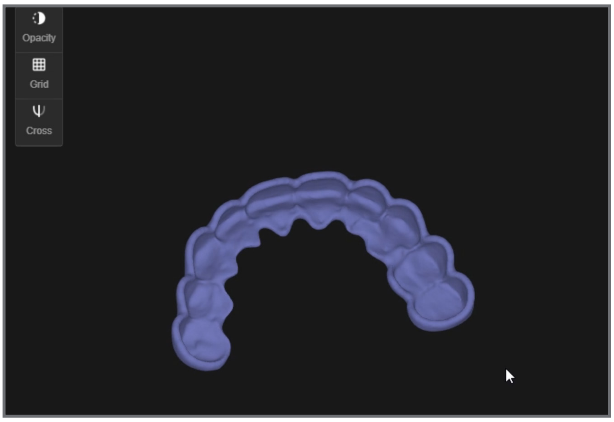


Figure 5

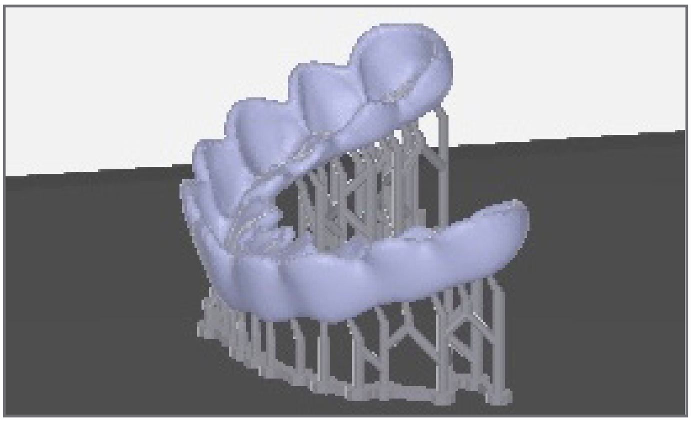


Figure 6

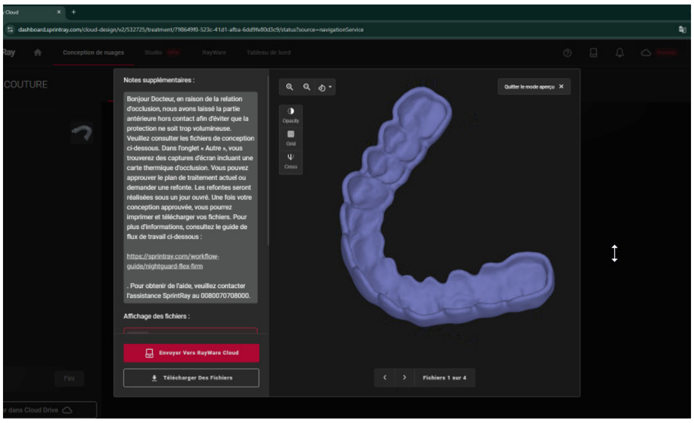


Figure 6a

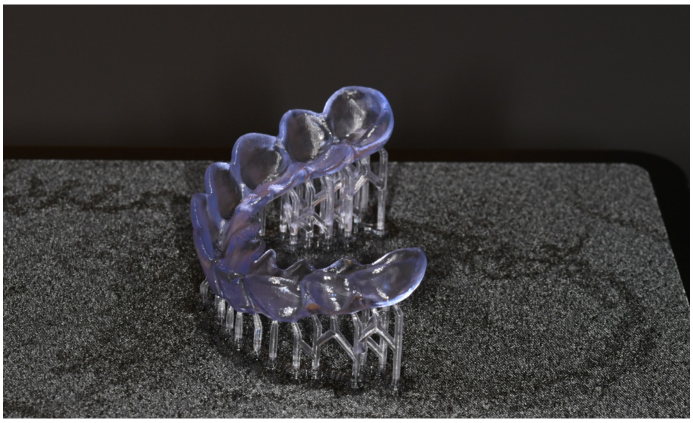


Figure 6b

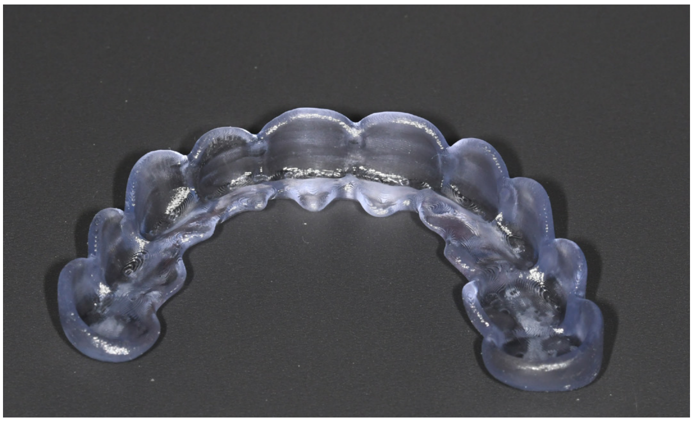


Figure 6c

Figure 6d

Creation of the final bridge:

At 6 weeks postoperatively, an X-ray is performed to check osseointegration (Figures 7), which allows visualizing the adaptation quality of the provisional bridge.

A second series of impressions will be made.


Figure 7a


Figure 7a


Figure 7b

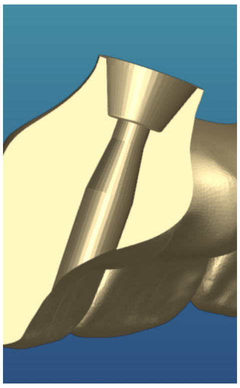


Figure 7b

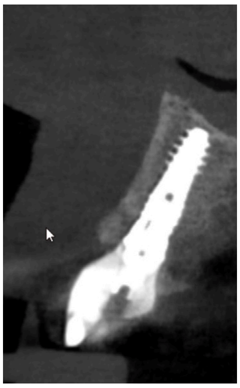


Figure 7c

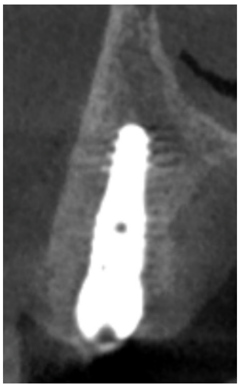


Figure 7d

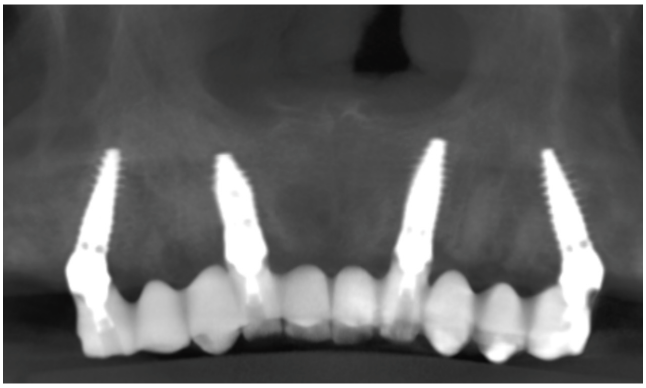


Figure 7e

A digital impression using DEXIS Imprevo will be taken with the provisional bridge in place, along with the antagonist and occlusion .

An impression of the underside of the provisional bridge will also be made to maintain the shapes of the emergence profiles on the final bridge.

On the initial optical impression, we will digitally remove the provisional bridge. We obtain an impression of the maxillary soft tissues oriented in space relative to the antagonist. The Thommen Medical Scanbodies specific for variomulti abutments are positioned, and the impression is made with the DEXIS Imprevo intraoral scanner.

The final bridge will feature a titanium framework screwed directly onto the variomulti abutments (Figure 9a) with conventional screws, offering the following benefits:

- Better adaptation to soft tissues
- Improved occlusion
- Enhanced aesthetics according to the patient's wishes

As with the provisional bridge, a deocclusion splint is printed to be placed on the day of its installation. This protocol allows the creation of the final bridge (Figure 9d) in two sessions (impression and placement) (Figure 9b, c).

Figure 9a

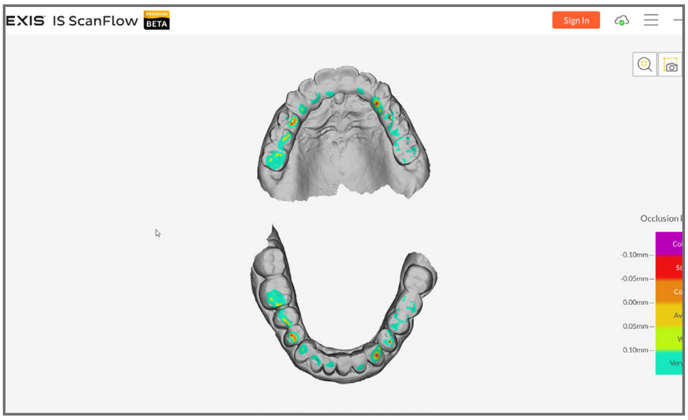


Figure 9b

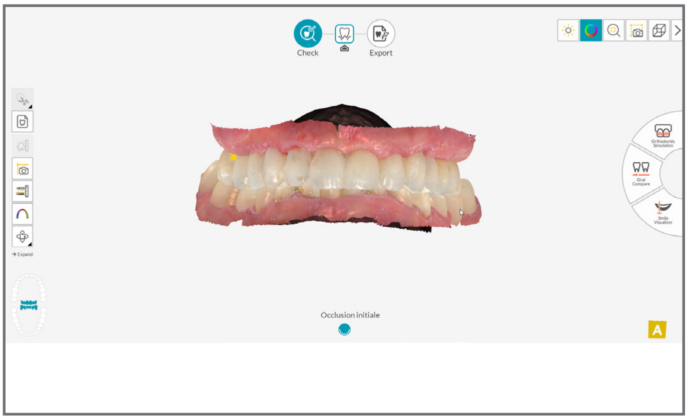


Figure 9c

Figure 9d

Conclusion

This protocol, combining optical impressions, guided surgery with stackable guides, photogrammetry, and 3D printing, allows treating patients in record time with unprecedented predictability. However, it is important to note that all these technologies are merely tools, and the skills of the dentist and prosthetist remain essential. A good mastery of the digital workflow, guide design, and surgical protocol is necessary to minimize risks and ensure long-term clinical success. The learning curve is not simple, and extensive communication with the prosthetist is required. It brings a lot of comfort to both the practitioner and the patient.

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