# Full-arch dentistry with dynamic navigation and photogrammetry

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**Nowadays, an increasing number** of patients are coming to our office with cases of implant failure, whether biological or aesthetic. Recovering from these situations is often complex, as a second failure is not an option. It is crucial to identify the causes of the initial failure and to use all the tools available today to perform both from a surgical and prosthetic perspectives.

How can we find a sustainable solution without incurring significant new costs of care? We will explore this through a common case, where a new workflow allows us to address these challenges effectively.

## Case presentation

Our patient is a 61-year-old female business owner who was referred to us due to discomfort with her upper implants, which she finds aesthetically unappealing. She places a high priority on her appearance and is determined to avoid any period without teeth.

The patient reports no systemic diseases, allergies, or medications.

The clinical examination reveals a marked loss of vertical dimension and a collapse of soft tissues and lips, although the upper lip remains intact (Figs. 1a–c). A high smile line is evident, exposing substantial crown height and showing noticeable offsets at the necks of teeth #11 to #22 in comparison to adjacent teeth.

Intra-orally, the patient has two cemented implant-supported bridges in the maxilla, spanning teeth #12 to #15 and #23 to #26. All other remaining teeth are crowned, except for teeth #18 and #28. In the mandible, an implant-supported bridge extends from teeth #35 to #37, and a substantial tooth-supported bridge spans from #44 to #48 (Figs. 2a–c). Clinical examination of the gingiva reveals signs of erythema and inflammation, with edematous and purulent areas, suggesting active periodontal disease as well as peri-implant disease.


**Fig. 1a:** Initial expression with a closed, natural smile. **Fig. 1b:** Relaxed open mouth smile. **Fig. 1c:** Full, confident smile showcasing unaesthetic implants. **Fig. 2a:** Left quadrant—side view of dental implants and restorations. **Fig. 2b:** Front view of dental work. **Fig. 2c:** Right quadrant—opposite side view of dental implants and restorations.

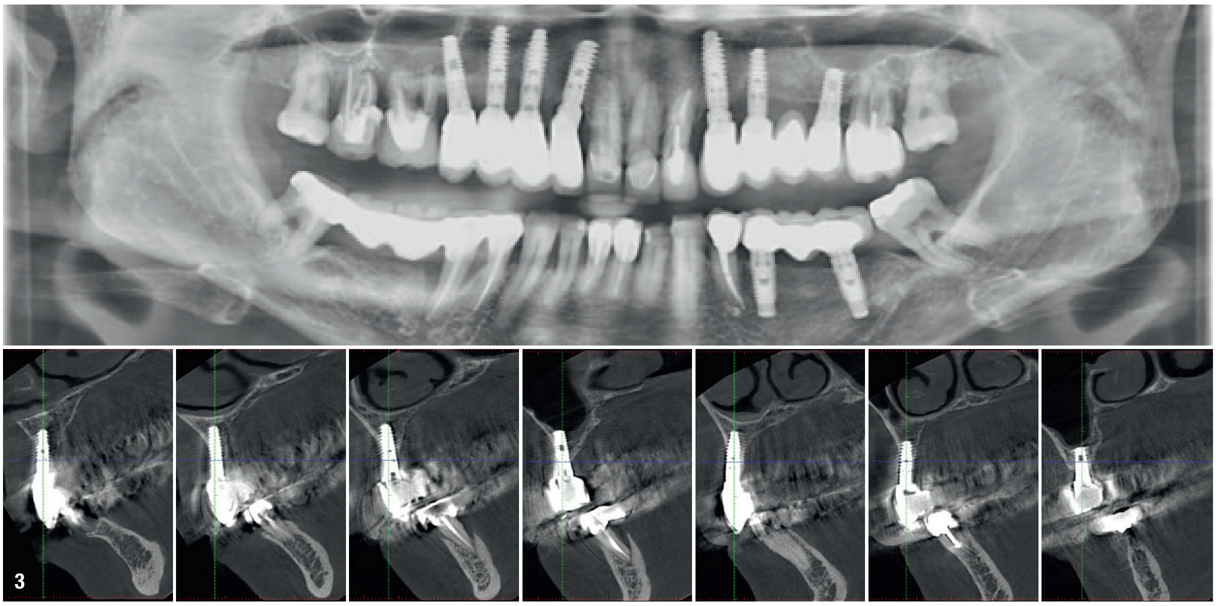



**Fig. 3:** Panoramic radiograph along with CBCT slides.

Radiographic findings further underscore these concerns, showing attachment loss characterised by angular defects and cratering around the maxillary implants, which were originally placed in 2017 (Fig. 3). A CBCT scan was conducted to analyse implant positioning and evaluate the remaining peri-implant bone structure, revealing additional details pertinent to the patient's periodontal and implant health.

## Treatment plan

We noted the patient's clinical complexity, with multiple compromised teeth and implants requiring extensive reconstruction and healing. To improve local conditions, we began periodontal treatment. During reevaluation, we assessed the prognosis of both teeth and implants based on their response to therapy and the patient's enhanced plaque control, all while considering her aesthetic priorities.

Temporary solutions were proposed to help the patient retain her teeth, accommodating her professional commitments. We informed her that management of quadrant four would follow maxillary treatment, as the mandible showed positive response to periodontal therapy, with maintenance every three months.

The maxillary treatment plan was deferred until reevaluation. Teeth #16, #17, and #27 were considered non-conservable due to periodontal issues. Significant bone loss in the vestibular area and the three-dimensional positioning complicated the aesthetic preservation of implants in sectors one and two.

Although there were no indications for extraction, teeth #11 and #22 presented aesthetic challenges. The patient expressed fixed solutions over removable prosthetics.

We evaluated the option of implant removal and tooth extractions, followed by placement of new implants and bone grafting; however soft-tissue quality and inadequate residual bone height made complicated predictable outcomes challenging.

Given the complexity of the case, we opted to use Navident dynamic navigation for precise implant placement and MicronMapper photogrammetry for the prosthetic phase. These technologies ensure optimal accuracy and predictability, ultimately enhancing the aesthetic outcomes we aim to achieve for the patient.

Final treatment plan:

- Step 1: Remove implants and extract teeth #16, #17, and #27; prepare teeth #11, #18, #21, #22, and #28; place a temporary PMMA bridge. Plan for soft-tissue thickening in three to four months.
- Step 2: Conduct bilateral sinus grafting via a lateral approach, with 2D/3D augmentation scheduled for six months afterwards.
- Step 3: Place eight implants; extract teeth #11, #18, #21, #22, and #28; place a functional bridge on the implants six months later.
- Step 4: Final placement of a definitive bridge.

## Implementation of the treatment plan

### Temporisation

Prior to the first surgery, the patient visited the clinic to gather necessary data for her temporary bridge. Photographs were taken to assist in bridge design, and a digital wax-up was requested. Once received, the wax-up and optical impressions were sent to the prosthetist to fabricate a PMMA bridge with teeth #11, #18,

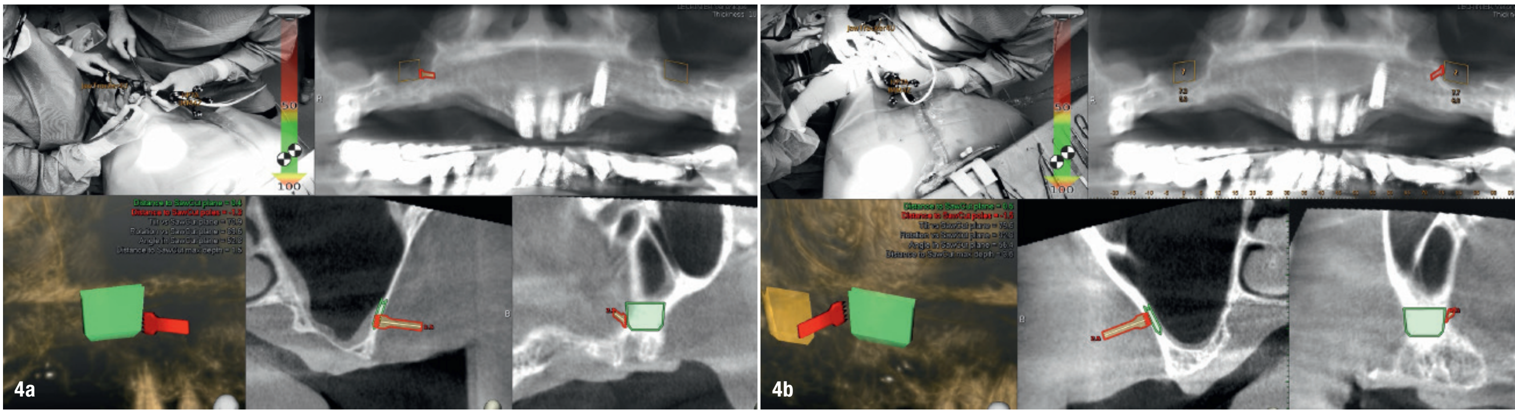



**Fig. 4a:** Left quadrant—navigated piezo surgery and saw cut. **Fig. 4b:** Right quadrant—navigated piezo surgery.

#21, #22, and #28 as abutments, ensuring thickened pontics.

We recorded the vertical dimension based on the maxillary wax-up and requested a 3D impression of the mandibular model for splints and composite injections for teeth #34 to #38 and #45 to #48.

All prosthetics and implant abutments were removed. At the extraction sites, A partial thickness flap was created while a full-thickness flap from teeth #11 to #22 facilitated implant removal with a left-handed wrench. Most extractions were straightforward, except for tooth #23, which required additional bone surgery. The partial thickness flaps also provided stabilisation for a connective tissue graft.

### Postoperative bone remodeling

Two months later, a CBCT scan showed insufficient volume after the removal of the implant and tooth extractions, necessitating remodeling of the maxillary sinus and horizontal augmentation.

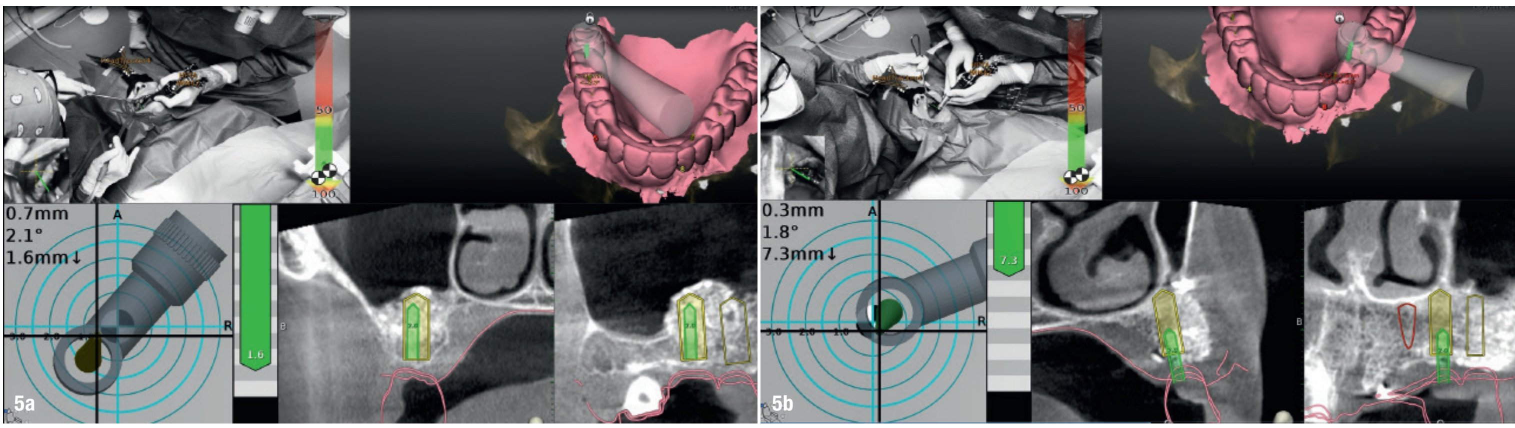
Piezo surgery was employed to elevate and remove the last implant at site 23, thereby creating a cavity to prevent titanium contamination.

The use of navigated surgery with the Navident EVO system provided precise control and improved access to the sinus windows, ensuring optimal positioning of the graft material. This was possible by first planning the accurate position of the cut in the bone, then executing according to the plan with precise navigation of the piezo blade. The Navident EVO's advanced tracking technology allowed for real-time adjustments, enhancing the accuracy of the procedure (Figs. 4a & b).

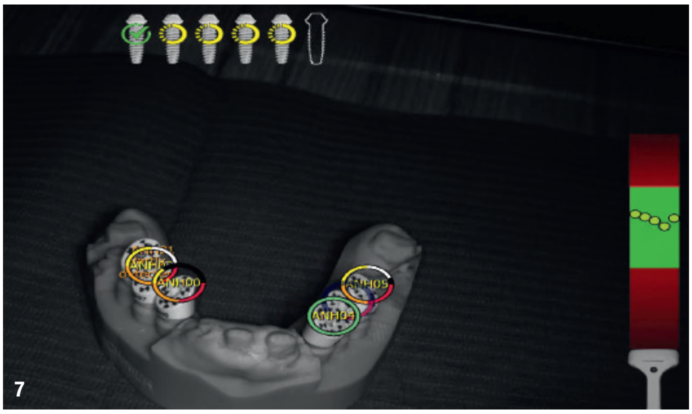
Horizontal ridge augmentations were performed following sinus grafts. Sutures were placed and the PMMA provisional bridge was repositioned. The patient is scheduled for follow-up appointments at 15 days, one month, and three months and has diligently adhered to postoperative recommendations.

### Implant and prosthetic phase

On the day of the implant surgery, we made a crestal incision positioned palatally, minimising elevation to avoid disrupting the previously grafted area. The access provided was adequate for implant placement using navigated guided surgery with Navident EVO, which offered real time tracking of the bone drills along all steps of placing the osteotomy. Using dynamic navigation allowed for




**Figs. 5a & b:** Navigated implant surgery.



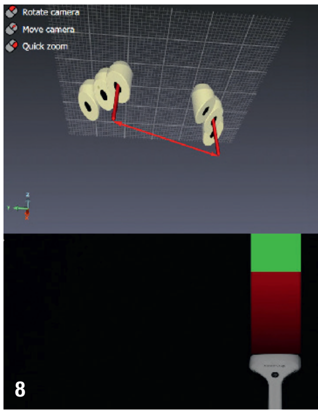



**Fig. 6:** Printed model with scan bodies. **Fig. 7:** Photogrammetry software showing scan progress. **Fig. 8:** Photogrammetry software showing scan and accuracy.

accuracy checks, precise axis management, and optimal placement of the implants while preserving crestal bone for placing definitive abutments.

We utilised Straumann BLC conical implants to achieve maximum primary stability and anchorage in the native bone, with the exception of sites 16 and 26. All implants were placed at torque levels exceeding 30 Ncm and we recorded the Implant Stability Quotient (ISQ) values ranging from 15 to 25 to confirm the torque during placement, with most values surpassing 70, except for site 14, which recorded 60.

Definitive SRA abutments with a gingival height of 3.5 mm were subsequently screwed in. Healing caps were placed while we managed the soft tissues, utilising the papilla rotation technique to bring gum tissue between each abutment, which was sutured to the palatal flap. We intentionally retained the residual teeth before and after implant placement to:

- Facilitate precise patient registration to use the Navident dynamic navigation system.
- Ensure alignment of implants with the preoperative impression where the wax-up of the functional bridge was placed (Figs. 5a & b).

### Photogrammetry using MicronMapper

The photogrammetry software uses scan bodies to capture implant positions with precision down to 20 microns. This level of accuracy is essential for achieving a true passive fit, significantly reducing risks like screw loosening and implant stress—factors crucial for long-term patient outcomes. By minimising manual adjustments and eliminating the need for verification jigs, MicronMapper enables clinicians to deliver faster, more consistent results with fewer patient visits.

We then placed the scan bodies to obtain a soft tissue optical impression. A second impression was taken with MicronMapper using photogrammetry to generate an STL file, which could be combined with both the preoperative and postoperative impressions. Our goal was to provide thorough information and accurate recordings to the prosthetist, aiding in the fabrication of a prosthesis that fits passively. Initially, we incorporated only the first six implants in the provisional bridge.

## Illustration of the workflow

The workflow carried out in the mouth is demonstrated using a printed model with analogues as no intra-oral photos were available (Figs. 6–8).

The lab technician gathers all this information in exocad software to complete the design of the new provisional bridge, ensuring it adheres to the previous design and occlusion of the original provisional bridge. The file is then sent back to the office for 3D printing of the provisional bridge in resin. This printing process takes 30 minutes, followed by an additional 20 minutes of postprocessing. The bridge is subsequently sandblasted with 50-micron alumina and cleaned with steam. Finally, a primer is applied before a light finish is done (Figs. 9a & b).

Ultimately, the provisional bridge, engineered for a passive fit, is placed one hour and 30 minutes after surgery,

**Fig. 9a:** Individual crowns, and printed provisional bridge. **Fig. 9b:** Side perspective, highlighting the contour and alignment.


10a


10b

**Fig. 10a:** Passive fitting prosthesis after new bridge and implants are placed (one month). **Fig. 10b:** Passive fitting prosthesis after new bridge and implants are placed (three months).


11a


11b

**Fig. 11a:** Pre-treatment image of patient with full confident smile, and unaesthetic implants. **Fig. 11b:** Post-treatment final result of restored implants and bridge.

with occlusion resembling that of the previous provisional bridge.

This immediate passive fit not only improves comfort but also saves time, reduces the risk of complications, and minimises the need for rework, facilitating better integration with the underlying structures (Figs. 10a & b).
The patient is scheduled to return for postoperative follow-up appointment at 15 days, one month, and again at three months.

## Follow-up treatment plan

The functional bridge will be kept in place for a minimum of six months to give the patient sufficient time to plan and complete her mandibular treatment (posterior sectors) before proceeding with the construction of the definitive bridge with the referring practitioner (Figs. 11a & b).

## Conclusion

Today, the patient requires comprehensive treatment, including periodontal care, aesthetics, occlusion as well as surgical and prosthetic precision.

The use of nano-filled ceramic resin transforms these temporary bridges into a functional, long-term bridge that can be modified or replaced in a very simple way, helping to reduce overall treatment costs for the patient.

Effective planning for each case is crucial to the success of our therapies and should be paired with efficient tools to be as reproducible and predictable as possible.

Special thanks to Dr Valentini, who greatly contributed to the success of this case study.

## about the author

**Dr Emilien Tronc** is a specialist in periodontology, oral surgery, full-mouth rehabilitation, and digital workflow integration. Based in France, he holds several advanced degrees, including the European Diploma in Oral Implantology from the University of Corsica.

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Literature