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Digital-LABS

Implant restoration of #25 using digital workflow and surgical guide

Solutions featured:

3Shape TRIOS® 3 MOVE® intraoral scanner
3Shape Implant Studio®

3shape

Figure 1. Initial radiograph

Figure 2. Periapical post-extraction radiograph

Case information

A 43-year-old male patient presents for consultation with an oblique fracture of the palatal cusp of his second left maxillary premolar. Unfortunately, the fracture has a juxtaposed bone margin that would require crown lengthening for its preservation, making the clinical crown-root ratio unfavorable. After discussing treatment options with the patient, an implant solution is chosen. The patient has requested a fixed prosthetic restoration that would be both aesthetic and preserve neighboring teeth. The extraction of the tooth is then performed, and the careful curettage of the socket allows to identify the presence of all the alveolar walls. We can therefore plan the implant treatment.

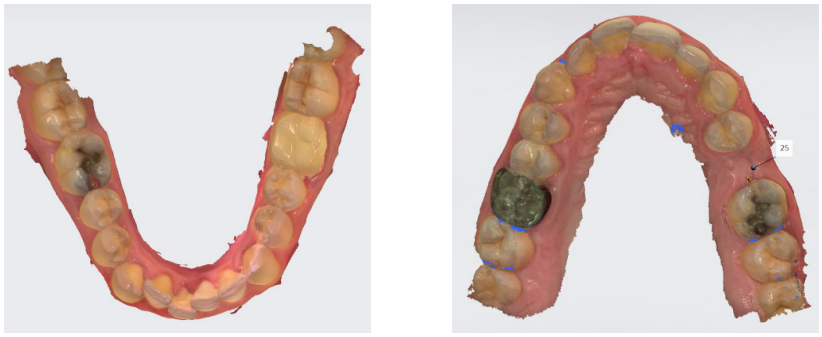
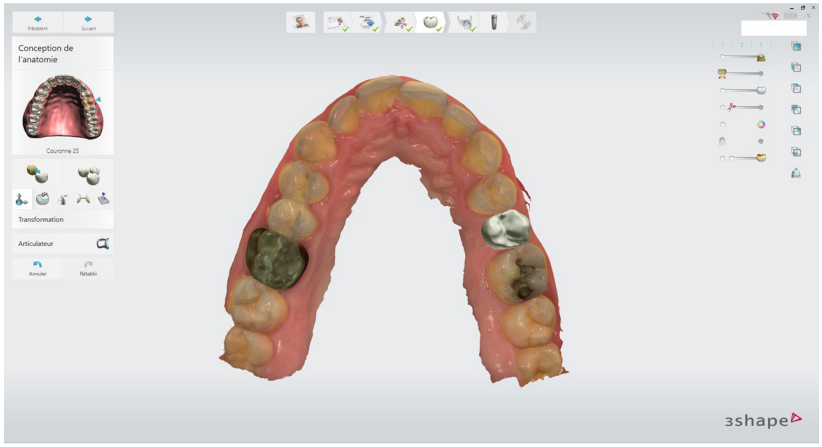


Figure 3. Digital impression of the patient's dentition after extraction site healing. Taken with 3Shape TRIOS® 3 intraoral scanner

Treatment plan

1. Digital preparatory phase

After the site has healed, a diagnostic impression is taken and a Cone Beam scan is performed.



To optimize the positioning of the future implant, the implant-supported crown is designed first in a prosthetic-driven workflow. There are several ways to design the crown: copy the contralateral tooth by mirroring it, choose a model from a library (standard or custom), or design the crown by correlating it with the anatomy of the adjacent teeth. In our case, since the palatal cusp is fractured, a model from the database was chosen.

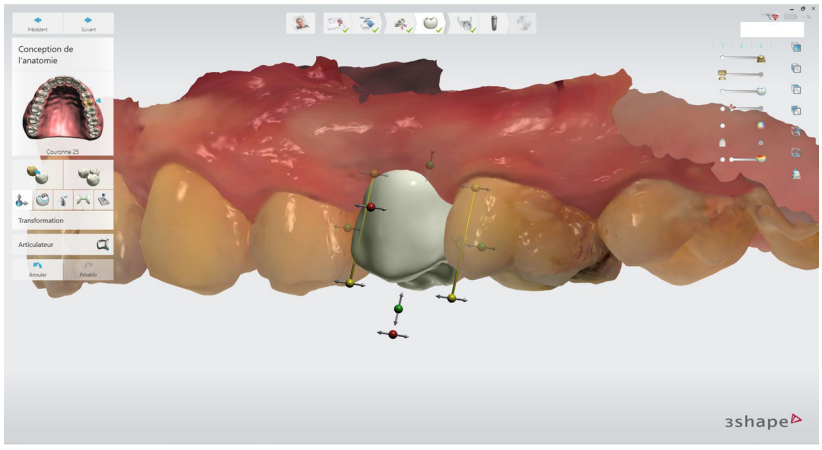


Figure 4. Design of the future prosthetic crown on tooth 25 (FDI notation)

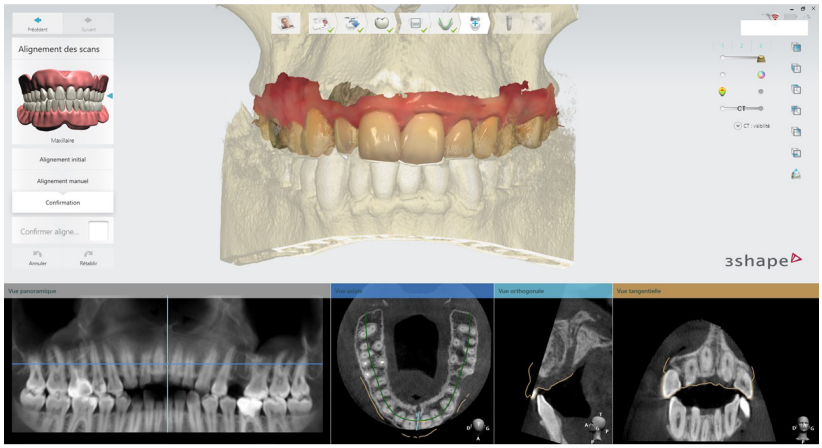


Figure 5. Alignment of the digital impression and the Cone Beam scan

Once the design is validated, we align the digital impression (.stl, or proprietary format in our case) and the X-ray scan (.dcm).

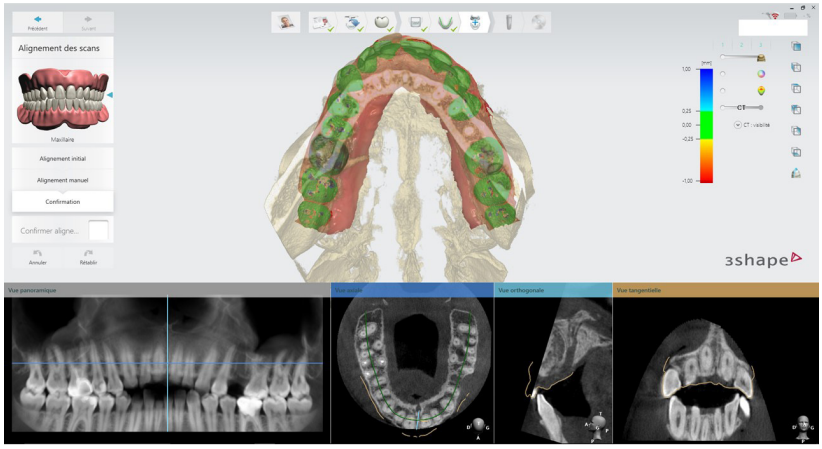


Figure 6. Validation of the alignment between the surface scan and the 3D X-ray scan in 3Shape Implant Studio®. A color code allows to immediately check the accuracy of the alignment of the two scans.

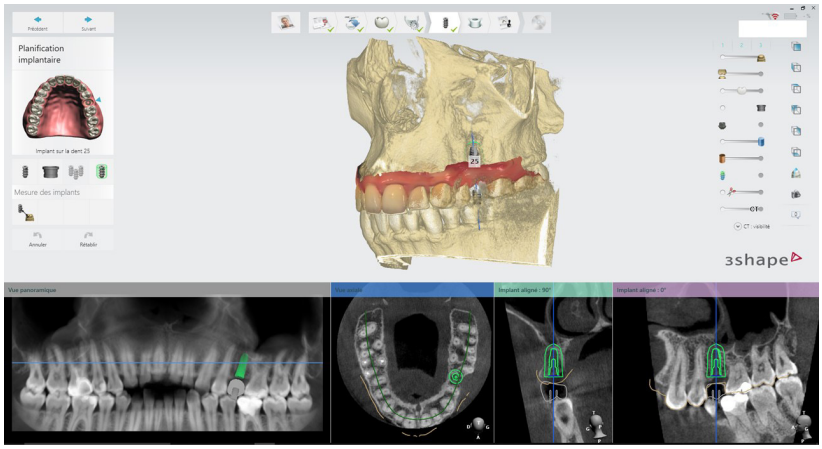


Figure 7. Implant planning based on the restoration design and the anatomical features on the CBCT scan

The implant is then positioned virtually depending on the bone volume, but also the orientation of the implant axis in relation to the future restoration. The analysis of the 3D tomography shows that the vestibular alveolar wall appears thin or even absent due to bone remodeling after extraction. A guided bone regeneration (GBR) technique must be planned for the operation. In addition, it is possible to shift the implant's position to the denser palatal alveolar wall to provide more support while keeping the screw hole centered on the occlusal surface of the future premolar.

Once the planning is validated, the patient is invited for an explanation of the different surgical steps of an implant placement as well as the possible use of a bone substitute if the bone architecture requires it peroperatively. This step is largely facilitated by the digital format that allows the patient to see the objectives we are trying to achieve, the surgical difficulties that may be encountered and the techniques at our disposal to overcome these obstacles. It also provides a time for reflection for the patient and involves him in his treatment. His consent is then all the more informed.

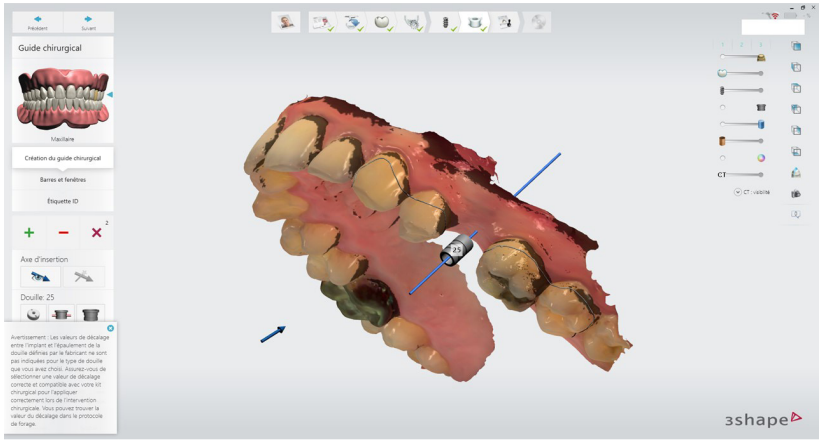


Figure 8. The undercut areas in brown help us to draw the outline of the surgical guide

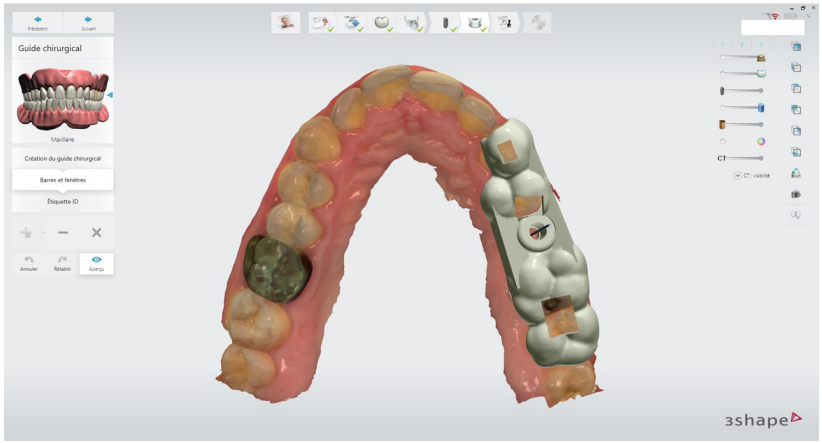


Figure 9. Design of the surgical guide with 3Shape Implant Studio

2. Surgical guide creation

Once the patient confirms his desire for implant treatment, the surgical guide is drawn. In the case of a single-tooth gap, a tooth-supported guide is the ideal solution.
The 3Shape Implant Studio® software initially suggests validating the insertion direction. The undercuts are highlighted based on this direction. The surgical guide must not go beyond this limit: otherwise, inserting the guide during surgery would be complicated or even impossible. There would then be a risk of incorrect placement of the guide, which would not allow to achieve the approved objectives. Nevertheless, 3Shape Implant Studio offers a compensation option to limit this risk.

With the same idea of validating the positioning, inspection windows are created in different places so that the surgeon can check the maximum insertion of the guide.

There are two types of surgical guides: pilot and fully guided.

Features of pilot guides:

- Adapted to the pilot drill of the implant system
- Cost-saving: no need to buy a guided surgery kit
- Less accurate than a fully-guided one

Features of guides for fully-guided surgery:

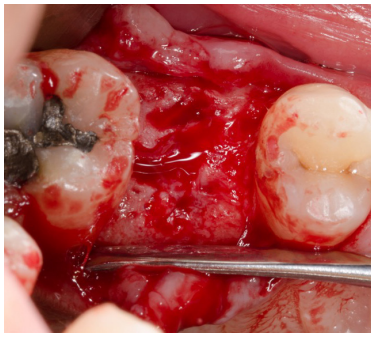
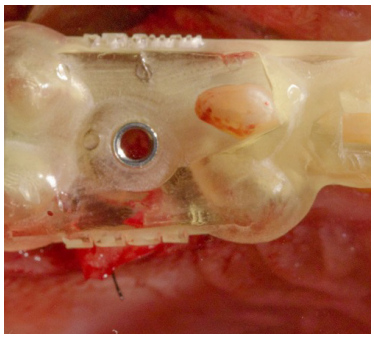
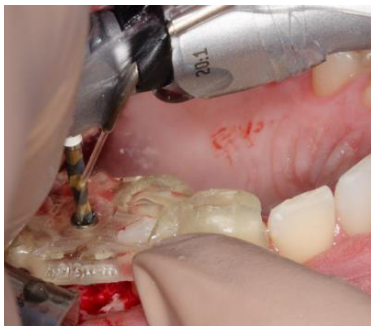
- Universal or specific to a guided surgery kit
- Can be used throughout the implant drilling sequence
- Sometimes impossible to use in limited prosthetic space

In this case, a pilot drill guide is chosen because of the small mesio-distal dimension of the site. For optimal stability, the guide extends to the second molar and support bars are added.

Once the design of the guide is validated, the guide is printed with a resin suitable for guided dental surgery – Dental SG Resin. This resin is biocompatible and can be autoclaved. Once the printing is done, the guide undergoes post-processing:

- Rinsing in an alcohol solution to remove resin residues,
- Photopolymerization in a UV chamber suitable for medical devices,
- Trimming of the residues,
- Disinfection of the guide in an appropriate antiseptic solution.

The patient is seen again for the try-in of the guide and for the preoperative prescription.

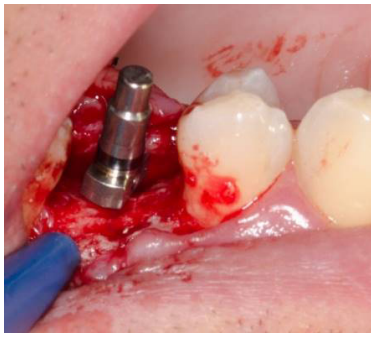
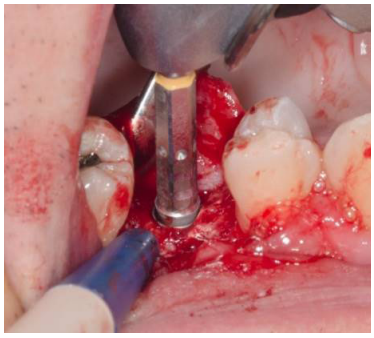
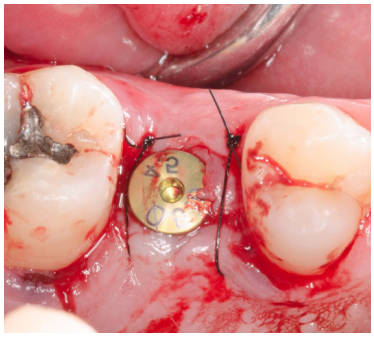




Figure 10. Surgical steps for placing an implant from Dentsply Sirona's Astra Tech Implant System EV

3. Surgical phase

In the surgical phase, the procedure is essentially the same. After making a full-thickness incision and reflecting the flap, the surgical guide is positioned. The clinical situation is very favorable, the vestibular alveolar wall is actually present. The pilot drilling can then be performed. The guide allows us to validate the direction and the emergence area, which are two key points in the prosthetic and implant success. The drilling sequence is then continued until the implant is placed.

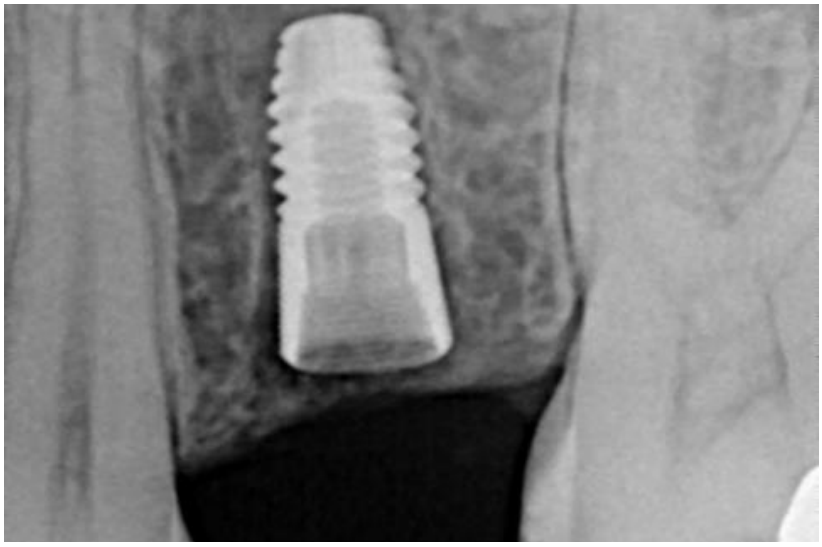


Figure 11. Periapical postoperative radiograph

In particular, the use of the guide will make the surgical procedure safer, which will also reduce operating time. Nevertheless, vigilance is still required, as the clinical sense will never be replaced by a device as efficient as it may be.

Figure 12. Additional digital scan to capture the gingival emergence profile

4. Prosthetic phase

After 3 months of bone healing, the prosthetic phase begins. The shade-taking is carried out. To facilitate the impression procedure, the first, diagnostic, scan is reopened. All we have to do is erase the implant area and the adjacent teeth on the first scan, and then rescan the anatomy and the emergence profile.

Figure 13. Scan body in place

A scan body is then placed and scanned with the intraoral scanner, allowing to determine the implant's position in space.

Figure 14. Digital impression of the scan body

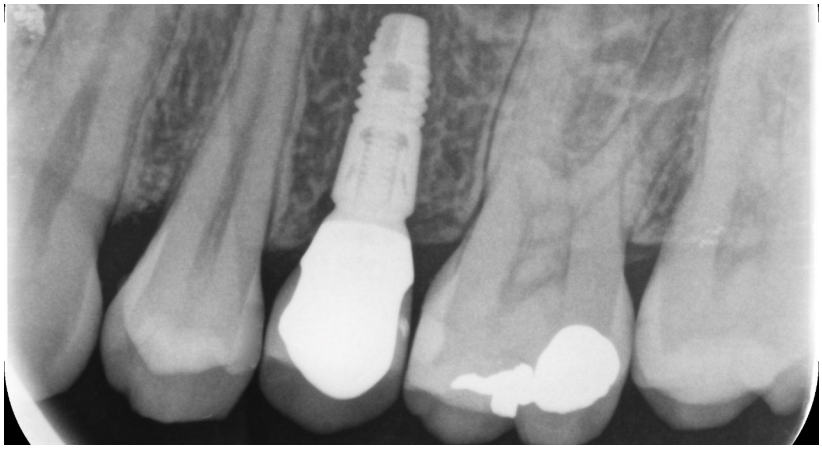


Figure 15. Follow-up radiograph of the implant restoration

Figure 16. Final restoration in place (Dr. Édouard Lanoiselée, Digital Labs (La Roche-sur-Yon))

The restoration is manufactured using the previously defined design and can then be tried in and screwed to the implant (Dr. Édouard Lanoiselée (Nozay), Digital Labs (La Roche-sur-Yon)).

Conclusion

Today, the reliability of implant treatments is no longer a discussion. The other side of the coin is that we are facing increasing demands from our patients. Even if we are not yet subject to an obligation of result, we nevertheless have an obligation of means toward our patients. But how can we make implant placement as predictable as possible?

With the evolution of digital tools, the Computer-Aided Design and Manufacturing (CAD/CAM) of surgical guides seems to be an appropriate solution. In addition to making the surgical procedure safer, surgical guides allow to reduce operating time and therefore to limit post-surgical morbidity. Moreover, with the prosthetic-based implant planning, they also improve the quality of the prosthetic work.

3Shape solutions enable an effective exchange of information with the patient throughout the treatment. In particular, Implant Studio® software can serve as a tool for explaining the therapeutic objectives, the potential surgical difficulties and the interest of using the surgical guide to ensure the long-term success of implant treatment. Nevertheless, it is essential to always evaluate the guide in its clinical sense, because, even with a GPS, a car needs a driver!

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About Dr. Éléonore Crauste

Dr. Éléonore Crauste is a general practitioner in a group practice in Nozay (France). She graduated from the Faculty of Dentistry in Nantes (France) in 2015.

After studying in Rennes, Dr. Crauste joined the Faculty of Nantes to complete her internship in Dentistry and her Master 2 Signals and Images in Biology and Medicine. Throughout her internship, she made sure to perfect her knowledge so that she could offer her patients comprehensive care. She thus obtained a University Diploma in Implantology and had the opportunity to explore different CAD/CAM systems. In her practice, she provides general care focusing on periodontology and implantology, and uses digital impressions (3Shape TRIOS® 3 MOVE®) daily for treating different prosthetic, implant, periodontal and aesthetic cases.

She is currently attached to the Oral Implantology Department of the Nantes Dental Care Center and teaches courses for the Nantes University Certificate of Oral Implantology, the Master 1 in Biology-Health and the undergraduate university curriculum.

About 3Shape

3Shape is changing dentistry together with dental professionals across the world by developing innovations that provide superior dental care for patients. Our portfolio of 3D scanners and CAD/CAM software solutions for the dental industry includes the multiple award-winning 3Shape TRIOS intraoral scanner, the 3Shape X1® CBCT scanner, as well as market-leading scanning and design software solutions for both dental practices and labs.

Two graduate students founded 3Shape in Denmark's capital in the year 2000. Today, 3Shape employees serve customers in over 100 countries from 3Shape offices around the world. 3Shape's products and innovations continue to challenge traditional methods, enabling dental professionals to treat more patients more effectively.

Let's change dentistry together

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