

Immediate implant placement and loading – a digital chairside workflow

In the last years, new technologies have been introduced to implant dentistry. For example, cone-beam computed tomography (CBCT) and computer-assisted implant surgery systems are used to determine the best position for an implant. By superimposition with computer-aided design data of the planned prosthetic restoration, a result-oriented plan can be developed. It is finally implemented by use of a drill guide.

Accuracy of guided surgery

In order to measure the accuracy of this workflow, numerous studies have been conducted. Most of them focus on a workflow that involves the production of a conventional working model based on an impression and its digitization with a laboratory scanner. The accuracy measurements are usually carried out by comparison of the initial CBCT scan including the planned implant position with a CBCT scan that shows the actual implant position. A systematic review of the literature^[1] reveals that the highest accuracy is obtained with the use of tooth-supported drill guides and a fully guided approach with implant insertion through the guide.

Integration of intraoral scanners

With the idea that it might be possible to optimize the process by use of an intraoral scanner, a new procedure was developed at the Academic Center for Dentistry Amsterdam. In this workflow, the initial impression is taken with the 3M™ True Definition Scanner. The device offers the benefit of capturing the soft tissue without difficulties due to the use of scan powder. The generated STL file is superimposed with the CBCT scan, the implant position planned and the implant placed. Then, the intraoral scanner comes into play again: A scanbody is placed and the situation scanned to compare the planned and the final implant position and to produce the prosthetic restoration. In this way, a second CBCT scan can be avoided.

Clinical trial

A clinical trial was conducted to evaluate the accuracy of this procedure: 148 implants were placed in a total of

70 patients using a fully guided protocol based on an intraoral and a CBCT scan. According to preliminary results, the implants were placed with higher accuracy in this study than in earlier investigations reviewed. The accuracy of the prosthetic procedure was assessed as well. For this purpose, the patients were split into two groups. In one group, a scanbody was placed and an impression was taken with the 3M™ True Definition Scanner. In the other group, a polyether impression was taken. Based on the impressions, monolithic crowns and bridges were produced. Without information about the previous process, the dental practitioner received and placed the restorations and evaluated the result by measuring the time needed for adjustments etc. The results showed that the intraoral scanner workflow was at least as accurate as the one starting with a conventional impression.

New chairside workflow

Against the background of increased patient comfort, a simplified workflow and higher efficiency related to the completely digital approach, I decided to implement the new workflow in the dental office Tandartspraktijk Rijnzigt in Arnhem. It is described using the following patient case.



Figure 1: X-ray showing internal resorption of the maxillary right lateral incisor.

Due to an internal resorption of the maxillary right lateral incisor (Figs. 1 and 2), the tooth fragment had to be removed in an emergency treatment (Fig. 3). Using resin composite, the fragment was bonded to the adjacent teeth and served as a bridge while the root remained in place (Fig. 4). In the same session, a digital impression was taken using the 3M™ True Definition Scanner and a CBCT scan was carried out. Figure 5 shows the STL file of the intraoral scan (Fig. 5).

Open source and highly accurate: Wiebe Derksen explains why these are the most decisive attributes of an intraoral scanner used in implantology. <https://youtu.be/8P8C-KdXgUg>



Figure 2: Clinical picture of the initial situation.



Figure 3: Extracted tooth fragment ...



Figure 4: ... bonded to the adjacent teeth as a temporary restoration.

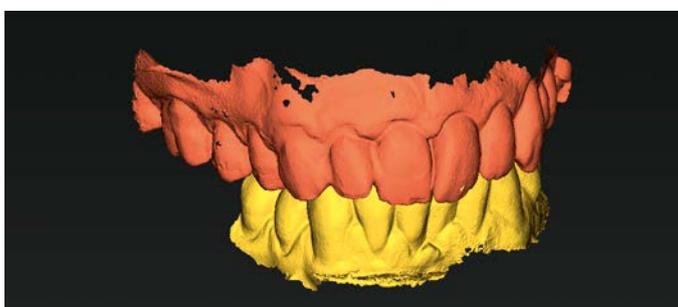


Figure 5: STL file of the digital impression.

Superimposition of scans

Subsequently, the two files of the computer-aided design and CBCT scan were superimposed in the planning software coDiagnostiX™ (Dental Wings) using

the teeth as a reference for matching. The ideal implant position was determined based on the patient's anatomy and the future prosthetic plan (Fig. 6).

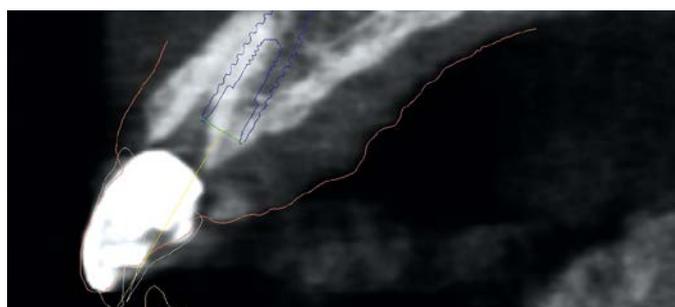


Figure 6: Planning of the ideal implant position.

The selected implant was a Straumann® Bone Level Tapered Implant with a diameter of 3.3 mm and a length of 12 mm. When the planning phase was completed, a drill guide was designed with the coDiagnostiX software (Fig. 7). The drill guide was immediately produced in the dental office using the DWX-4 dental milling system (Roland DG). This machine is capable of milling transparent PMMA material suitable for guide production and has a small footprint so that it can be easily integrated into every practice.

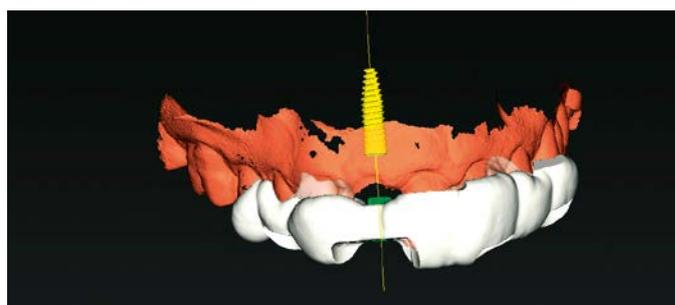


Figure 7: Design of the drill guide.

Crown design

The information about the future implant position was exported to the laboratory design software DWOS (Dental Wings). Based on this position, the design was created and the emergence profile optimized (Fig. 8). This step is optional prior to implant placement, but offers the advantage of a time-saving workflow when the temporary crown is milled for immediate restoration while the patient is still in the chair. Due to the anatomical shape of the patient's bone, the restoration had to be designed with an incisal screw access hole.

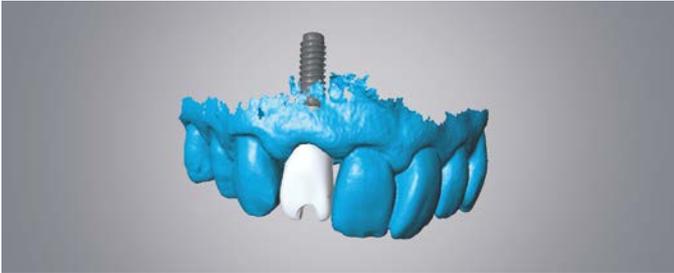


Figure 8: Preliminary design of the temporary restoration.

Implant placement

The implant was placed six weeks after the emergency treatment and immediately after atraumatic extraction of the root (Figs. 9 and 10) using the prepared guided surgery protocol (Fig. 11).



Figure 9: Clinical situation after atraumatic extraction of the tooth root.



Figure 10: Occlusal view of the extraction hole.



Figure 11: Guided implant placement.

Since slight inaccuracies cannot be avoided in this guided implant surgery process, it was decided to take into account the final implant position for the production of the temporary crown: An intraoral scan was carried out immediately after implant placement. For this purpose, a Straumann® CARES® Mono Scanbody was fixed on the implant (Fig. 12) and some powder applied to it and to the adjacent teeth.



Figure 12: Scanbody fixed on the implant immediately after its insertion.

Temporization

Finally, the new scan file was imported into the DWOS software (Fig. 13). The predesigned crown was adjusted in a way that it matched the final implant position exactly (Figs. 14 and 15). Thanks to the pre-surgical design step, this procedure took just a few minutes. The temporary crown was milled in the dental office using a hybrid material with tooth-like properties (Fig. 16), luted to a titanium-alloy bonding base (Straumann® Variobase™ Abutment), polished and screwed onto the implant in the same appointment for immediate restoration (Fig. 17). The provisional crown was placed slightly out of occlusion (without functional loading) to provide for favourable healing conditions. The incisal screw access hole was closed with 3M™ ESPE™ Filtek™ Supreme XTE Universal Restorative (Figs. 18 and 19). The definitive restoration will be cement-retained to avoid the aesthetic limitations associated with the visibility of the screw hole.



Figure 13: STL file of the second digital impression.

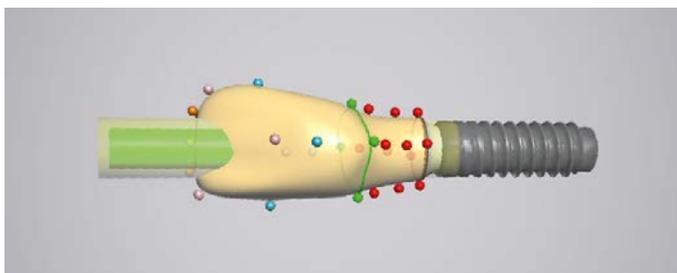


Figure 14: Final computer-aided design ...

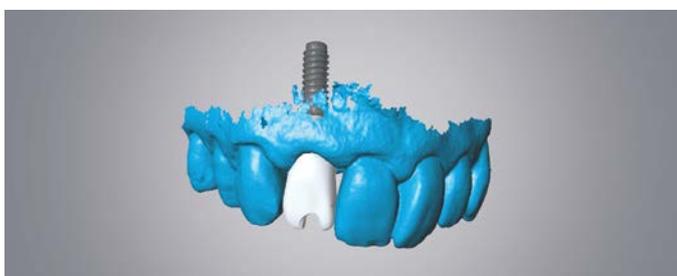


Figure 15: ... of the temporary crown.



Figure 16: Milled restoration in the blank.



Figure 17: Provisional crown in place.



Figure 18: Situation after final adjustments with filling material.



Figure 19: Buccal view of the temporary after finishing.

Conclusion

The present patient case shows that the described combination of digital technologies leads to very good clinical results. The dental practitioner is able to improve the accuracy of implant placement using a guided approach and the precisely fitting temporary restoration is ready to be placed within an hour after completing the surgical procedure. And last but not least, the patient benefits from increased comfort due to the use of an intraoral scanner and a reduction in the number of required appointments. The procedure is currently used for single tooth replacement on a regular basis in our dental office, while we are currently focusing on the development of a workflow for multi-unit restorations as well. The final restorations are always produced in a dental laboratory.

[1] Tahmaseb A, Wismeijer D, Coucke W, Derksen W. Computer technology applications in surgical implant dentistry: a systematic review. *Int J Oral Maxillofac Implants.* 2014;29 Suppl:25-42. doi: 10.11607/jomi.2014suppl.g1.2.



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