Thinking backwards—digital workflow using SIMPLANT with ASTRA TECH Implant System EV

Author_ Dr Christian Mertens, Germany

Summary

Patient
A 50-year-old male patient missing tooth 26 asked for an implant-supported crown.

Challenge
The patient wished to combine implant placement and insertion of a provisional crown in only one treatment session.

Treatment
Using a CBCT scan of the clinical situation imported into the SIMPLANT software, a customised ATLANTIS Abutment, as well as a provisional crown and a surgical guide, were fabricated before surgery. On the day of implant placement, the abutment and provisional crown were incorporated, following the Immediate Smile concept.

Case study

Planning
Planning for dental implants starting from the desired crown position (backward planning) has been an intrinsic part of implant therapy for years and is implemented successfully by many treatment teams. This case presents a treatment protocol in which the advantages of backward planning were realised using SIMPLANT computer-guided treat-
ment planning with the new ASTRA TECH Implant System EV. By eliminating analogue working steps and moving to exclusively digital planning and production of all prosthetic components, new and greatly simplified technical solutions can be developed prior to the actual implant placement.

Precise and careful planning of each individual implant position in light of prosthetic considerations is an essential requirement for the surgical and prosthetic success of implant therapy. Today, modern implant-related concepts are only regarded successful when the prosthesis satisfies current aesthetic demands. So-called backward planning can be used to determine the implant choice and position. This requires three-dimensional planning and implementation of the obtained information (by means of CBCT/CT, digital set-up) in an implant-planning programme in which all the data can ideally be combined. SIMPLANT from DENTSPLY Implants is one such programme. Not only does it make it possible to plan the implant position, taking prosthetic guidelines into account, but it also offers an interface for prosthetic restoration with ATLANTIS. This makes a digital workflow and the resulting advantages possible and feasible in the ordinary practice.

Initial situation

The patient wished to restore the tooth that was missing in position 26. Presented with treatment options, he declined a conventional bridge on account of the invasive procedure that would be required on the adjacent teeth. Instead he opted for an implant-supported prosthesis with an ATLANTIS Abutment (DENTSPLY Implants), delivered following the Immediate Smile concept. After guided placement of the implant and achievement of primary stability, the treatment plan called for immediate placement of a custom abutment and temporary crown. The patient was thereby managed adequately in only one treatment session.

An impression was taken of the initial situation, and the models were digitised using a conventional laboratory scanner. Volumetric computerised tomography (CBCT) was also employed. Besides clinical assessment of the initial situation, radiographic diagnostics to evaluate bone structure, bone quantity, and the status of neighbouring anatomic structures should be included in such planning.

Implant planning in SIMPLANT

With a few steps, the patient’s case was then entered in SIMPLANT. The CBCT data were imported first. Next the STL data of the model and digital wax-up was loaded. The SIMPLANT software is an open solution that can be used with all DICOM-compatible (CB)CT scanners and conventional STL-compatible laboratory scanners or intraoral scanners. The superimposed data shows an exact picture of the anatomic and prosthetic situation. The bone surface was displayed by the software in a different colour from the surface of the model (teeth and soft tissue) (Fig. 1). Prior to implant planning a digital wax-up was created in the 3Shape software. To do this, the corresponding tooth was selected from a tooth library and positioned in the gap. The tooth was adjusted to the available space in a few steps. The implant was virtually positioned in the bone with reference to the available bone and anticipated occlusal loads and the ideal length, diameter, and position for the implant were defined, taking the specification of the prosthesis into account.

More than 100 implant systems are stored in the SIMPLANT software library; in this case it was decided to use the new ASTRA TECH Implant System EV (DENTSPLY Implants), which meets the demands of...
modern implant dentistry with its simplified surgical and prosthetic protocol. Prosthetic restoration with patient-specific ATLANTIS abutments has been greatly simplified by the innovative connection design (one position only). The individually fabricated ATLANTIS Abutment for the Astra Tech Implant System EV is only placed in a single position. A malposition abutment is thus a thing of the past. A tooth-supported SIMPLANT SAFE Guide was ordered in the SIMPLANT software (Fig. 2) and the Immediate Smile featuring ATLANTIS Abutment option was chosen. In this fully digital workflow, the SIMPLANT plan is used to create the SIMPLANT Guide as well as an ATLANTIS Abutment. A design proposal of the abutment was sent to the treatment team, which can be loaded into SIMPLANT for review of the case, and modified if necessary using ATLANTIS 3D Editor (Fig. 3). After approval of the construction, CAM-supported fabrication of the abutment took place in the desired material; in this case, titanium.

Fabrication of the temporary crown

In the ATLANTIS WebOrder, ‘dispatched’ status appears after the abutment is ordered, indicating that the ATLANTIS Abutment Core File can be downloaded. The core file data correspond to an exact reproduction of the ATLANTIS Abutment and act as the basis for fabrication of the temporary crown. As the data are made available in an open format, it is possible to work with conventional CAD software and ordinary CAM technology (Figs. 4 & 5). To simplify the design process, the core file displays the abutment without a screw channel. On the outer surface of the planned abutment and in the region of the cervical margin, the file corresponds exactly to the actual abutment. Through an articulator integrated in the software, the lines of movement can be tracked and static and dynamic occlusion adjusted. Following construction, the temporary crown was fabricated by the dental laboratory from a high-quality composite using CAD/CAM (Fig. 6).

Planning the surgical procedure

The implant position and alignment as determined from the three-dimensional data must be transferred to the patient during the surgery. Drilling of the implant site should correspond as accurately as possible to the position previously simulated in the software. To ensure this, a drilling template (SIMPLANT SAFE Guide) and necessary drills were ordered in the SIMPLANT online shop as described previously. This innovation of ordering all drilling components together with the template, based on the planning, facilitates implant placement enormously. The dentist receives a list of drills required, and they can be deselected if the dentist has already received them for use in a previous case. In the present case, only the sleeves needed for the individual patient were required.

After being ordered, the template was fabricated by stereolithography (a type of 3-D printing) in the SIMPLANT production site.

Placement of the implant

Placement of the implant with gradual preparation of the bone cavity. Prior to the surgical procedure, the drill template, the individual set of drills and drill protocol, the patient’s custom abutment, and the temporary crown were all at hand so that, assuming primary stability was achieved, immediate restoration with the definitive abutment and temporary could take place. All components were disinfected, and the patient was given local anaesthesia. The drill template was fixed securely on the neighbouring teeth, and the soft tissue was first pierced with a tissue punch so that the implant
could be placed without creating a flap (Fig. 7). The next step was introduction of the initial drill. This removed the previously pierced soft tissue fully and ensured exact predrilling, as the tip of this drill is designed to avoid drifting off course even when it meets an oblique bone level (Fig. 8). When drilling into the bone, the maximum speed of 1,500 rpm was not exceeded, and saline solution was used for external cooling. Bone heating can be avoided, and a pump effect to remove bone tissue efficiently can be generated by an intermittent drilling technique. The evolution of the new system is also apparent in the sharpness of the drills. The very dense bone in this case, where immediate restoration was planned, could be prepared without pressure and therefore without any risk of bone necrosis.

Preparation was continued with ASTRA TECH Implant System EV/GS no. 1 and no. 3 drills. These have a depth stop that prevents too deep drilling preparation, and they can be used for preparation of two different implant lengths. This is enabled by positioning the sleeve at a different height or depth in the template, depending on the implant length (Figs. 9 & 10). The conical A/B drill is then used to prepare the bone in the crestal region. This drill does not have a depth stop like the other instruments but has laser markings on the shaft. The surgeon can thus use the bone quality to control the desired preparation depth (Fig. 11).

Surgical tray

The completely redesigned surgical tray leads intuitively through the sequence of drills and comprises all the information necessary for using the components. During implant placement, it is ensured that the depth markings on the placement instrument are at the same level with the Safe Guide in accordance with the implant lengths. Since an ATLANTIS Abutment produced prior to the surgical procedure was used in this case, a further unique feature should be noted: the placement instrument has six cams, one of which is bigger and deeper than the other five; this cam must be exactly in line with the groove in the guide. This guarantees correct alignment of the implant, which ensures one-position-only placement of the abutment and thus an exact fit of the abutment and temporary crown (Fig. 12). This unique interplay of hardware and software enables use of the Immediate Smile concept for single-tooth restorations, distinguishing SIMPLANT from other guided surgery systems (Figs. 13 &14).

After taking a control radiograph, the temporary crown was connected to the abutment. The course of the actual treatment session was very structured and straightforward because of the precise preliminary work and template-guided implant placement. The patient left the office with an immediate implant-supported restoration (Fig. 15).

Conclusion

For backward planning, with specification of the prosthetic objective to implant positioning, digital possibilities are increasingly an asset for the treatment team. These include guided implant placement, which ensures efficient and precise implementation of the planning. With innovative treatment concepts such as the Immediate Smile concept and ATLANTIS Abutment, the digital planning components can be combined in one project file. Only one data set is needed, from the virtual elaboration of the set-up through three-dimensional diagnosis of the available bone and planning of the implant position to construction of the patient’s custom abutment and CAD/CAM fabrication of the temporary restoration.

Due to the template-guided implant placement and gradual preparation of the implant bed, the implant position that was planned three-dimensionally can be transferred precisely to the mouth with relatively little effort. If the necessary primary stability is achieved, immediate restoration can be carried out with a patient-specific abutment (ATLANTIS) and temporary crown. This results in a simplified procedure for implant-based immediate restoration of a single-tooth gap. Backward planning using coordinated hardware and software is an important part of implant-based treatment concepts in daily work, enabling the primary benefit of immediate restoration—a significant shortening of treatment time—to be optimally exploited.