

Dentist's services and chairside "laboratory" services in guided implant placement

Surgical guides

Jörg Neugebauer^{1,4,5}, Kerstin Salhoff², Steffen Kistler¹, Frank Kistler¹, Günter Dhom^{3,4}, Germany

As cone-beam computed tomography (CBCT) becomes more ubiquitous, indications for the technique of guided implant placement are becoming more common.

Any justification for the use of guided implantation must take into account the exposure to ionizing radiation. State-of-the-art equipment with radiation-sensitive detectors can help to reduce the radiation exposure by using different radiation parameters e.g. pulsed radiation and an additional copper filter in the low-dose programme.¹⁵ Although the current guideline for the use of navigation-guided implant surgery has not been updated for more than five years, the indications listed therein are still clinically relevant today (Table 1).¹²

As radiological diagnostics are generally still required for navigation-guided implant placement, it is recommended that this diagnostic step be performed with CBCT according to the updated dental CBCT guideline. Accordingly, this guideline contains numerous recommendations that justify a three-dimensional diagnostic approach (Table 2).¹

The adoption of the 2012 German Standard Schedule of Fees for Dentists (GOZ) has provided clarity in one area of implant planning and implant placement, the use of navigation guides. The use of a custom guide in the implant-related analysis and measurement of the alveolar process to determine the correct implant position is now covered by the schedule. Similar provisions in other jurisdictions or under other fee schedules to ensure appropriate reimbursement for this step appear appropriate. Customised diagnostic guides are defined as radiographic templates for 3D diagnostics that may include radiopaque reference bodies for specific planning programs in 3D diagnostics or reference spheres for adjusting 2D diagnostics.⁹

Tools for implant placement

Orientation and navigation guides that require various dental and laboratory steps to prepare for fabrication and application. The use of a navigation guide for implant placement by the clinician involves a separate billable step, namely the insertion and use of guided instruments, steps that are not required, or not to the same extent, for freehand placement or when using an orientation guide. The fabrication of a navigation guide is an additional laboratory step, performed by a planning centre or a

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| Patients with special risks (e.g. increased bleeding tendency) |
| After complex jaw reconstruction |
| Support for the implementation of a difficult prosthetic objective |
| Special concepts (e.g. for immediate restoration with prefabricated dentures) |

Table 1: Indications for navigated implant placement.

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| Missing or insufficient information from clinical examination and two-dimensional imaging |
| Prosthetically driven implant planning |
| Distinct anatomical features: <ul style="list-style-type: none"> • Submerged alveolar processes • Severe atrophy of the alveolar process • Maxillary sinus septa |
| Special surgical and/or prosthetic approaches <ul style="list-style-type: none"> • Immediate implant placement • Immediate restoration • Navigated implantology • Complex interdisciplinary treatment approaches |

Table 2: Indications for three-dimensional implant diagnostics.

dental technician, and is charged to the patient as part of the laboratory bill.

The fabrication of a navigation guide is an additional laboratory step that is performed by a design centre or by a dental technician and will be charged to the patient as part of the laboratory bill. However, because modern programs can be operated by a dentist in his or her office, this step may also include certain chairside services that should be billed as dental services if they are not specifically included in the treatment plan and cost estimate. These chairside "laboratory" services must be billed at the dentist's individual hourly rate.

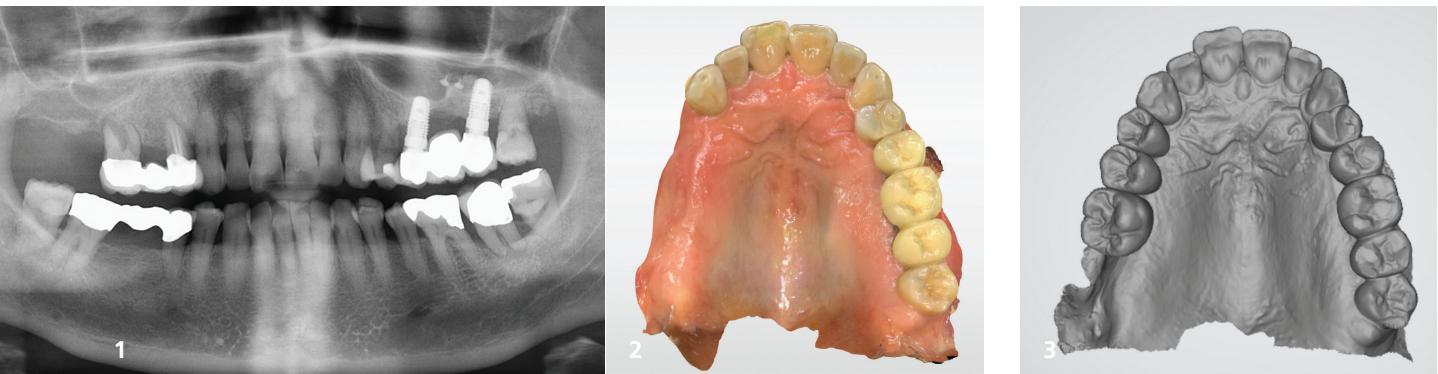


Fig. 1: Preoperative radiograph prior to placement of two ceramic implants. **Fig. 2:** Intra-oral scan for implant planning (CEREC Primescan, Dentsply Sirona). **Fig. 3:** STL data set with prosthetic proposal.

Making a navigation guide

There are several procedures that use navigation guides for precise implant planning, using a virtual model on the computer with the aid of a three-dimensional radiograph produced by CBCT according to the guidelines.¹⁰ This procedure involves several steps, some of which must be performed digitally or conventionally in the laboratory, depending on the system used.^{5,13,14}

In order to prepare the CBCT, a radiographic template must first be used if the system works with a reference plate or ref-

erence bodies.⁷ Ideally, the desired prosthetic result is simulated in this radiographic template by transferring the prosthetic set-up into a radiopaque resin (e.g. by doping with barium sulphate) so that it can be visualised on the radiograph.²

With the increasing availability of intra-oral impressions, digital planning documents can be created directly by the clinician to visualise the desired prosthetic outcome. This involves creating a virtual set-up to be created in a design program after reviewing the optical scan or intra-oral image. If immediate implant placement is planned, the tooth to be extracted may need to be digitally “removed”.

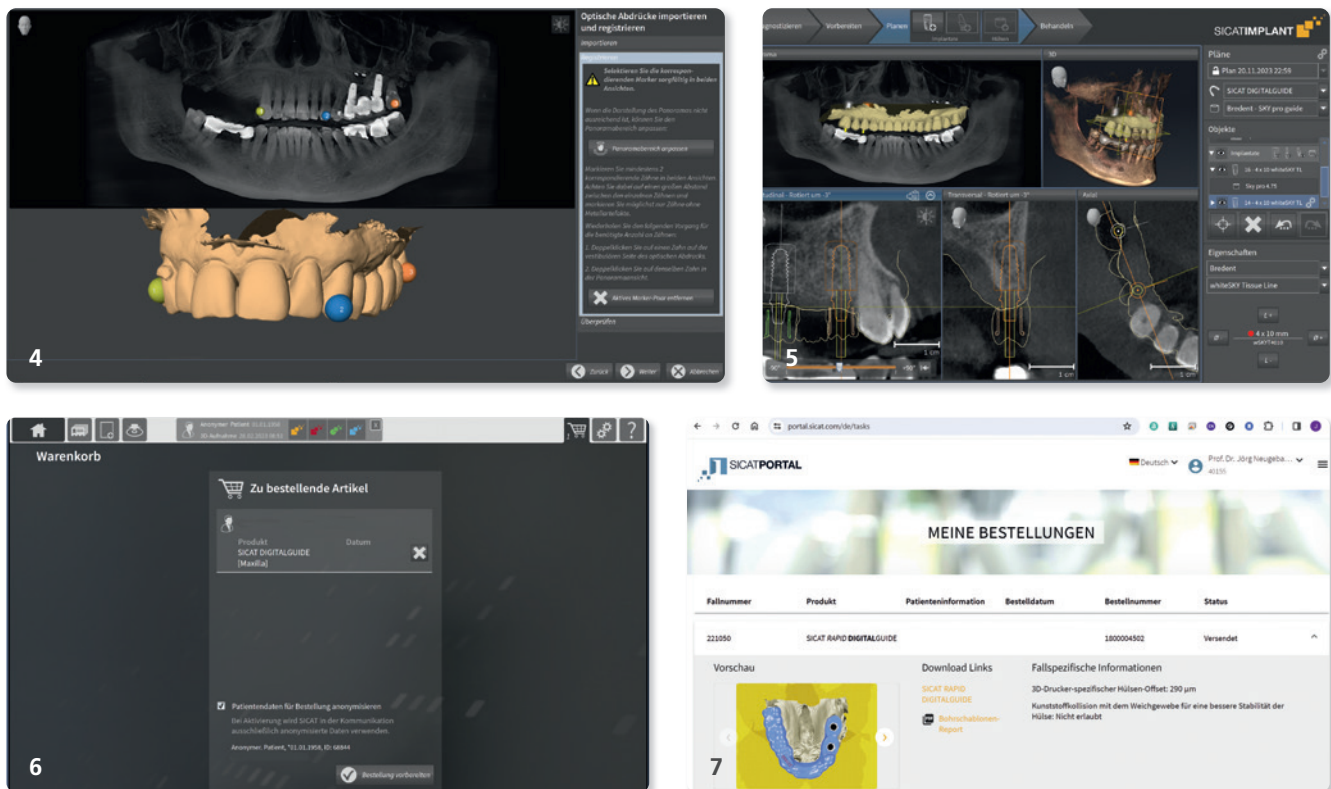


Fig. 4: Superimposition of the data sets in the design program (SICAT Implant 2.0, SICAT). **Fig. 5:** Prosthetically driven positioning of implants with drill sleeves for guided systems (SKY pro guide, bredent medical). **Fig. 6:** Preparation for design export. **Fig. 7:** Download of the navigation guide created with AI (SICAT RAPID DIGITALGUIDE, SICAT).

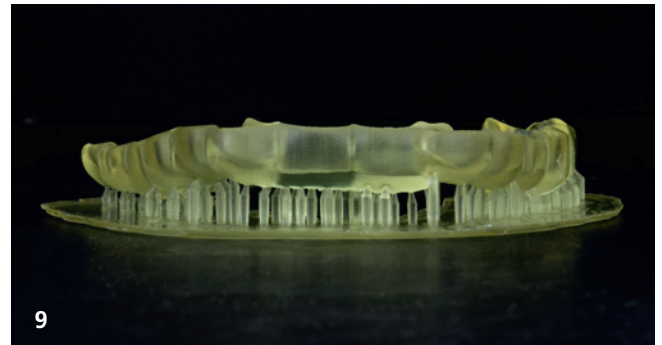
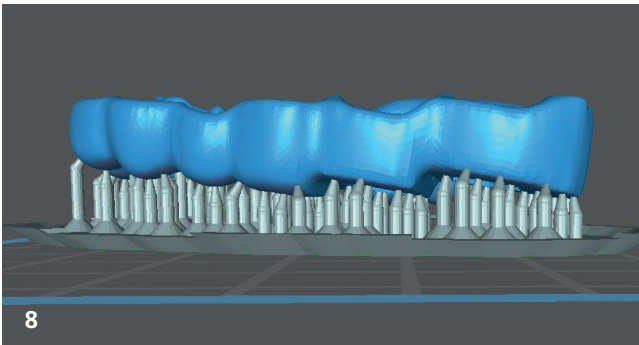


Fig. 8: Navigation guide prepared for printing. **Fig. 9:** Printed navigation guide before sprue removal. **Fig. 10:** Finished navigation guide with fixed master sleeves. **Fig. 11:** Use of the drilling guide with guided implant instruments.

This digital data can then be superimposed on the radiographic data set. Depending on the design program, a combined data set derived from the surface scan and the prosthetic proposal may be required. Alternatively, two data sets must be available – one representing the surface scan and the other representing the prosthetic proposal—for virtual planning to be possible.¹¹

After these steps, the implant position can be determined and the appropriate implant dimensions selected. This selection must be checked for plausibility by the design program. In addition to dimensionally accurate models of the implant bodies, most programs can select and simulate abutments with the appropriate angulations.

Once the position of the implants has been checked against the relevant anatomical and prosthetic parameters, the sleeves can be selected and positioned for the design program. Again, a plausibility check will be required as different sizes of drilling sleeves are available, depending on the intended instrument set for guided implant placement. These sleeves must not collide with the anatomical structures, such as terminal abutment teeth or high mucosal thickness in flapless procedures, or with the sleeves of adjacent implants.

Once the implants have been aligned with the drilling sleeves, the data transfer for the design of the surgical guide can be prepared. Using a web-based portal, all design data can be transferred digitally, eliminating the need to send patient documents to the design centre by post.

As these digitally designed surgical guides are printed in the practice or at a collaborating laboratory, it is necessary to enter the specific production parameters for the printer used. The so-called printer offset is determined by printing a reference body. The individual offset can be determined by inserting the drill sleeve into different-sized holders. This step is necessary once so that the metal sleeves can be easily fixed in the navigation guide.

The guide can then be constructed at the design centre. Alternatively, this step can also be generated by an automated process supported by artificial intelligence. This approach has the advantage that the design is independent of human resources and working hours. On the other hand, this process requires an additional plausibility check of the design to determine whether the resulting navigation guide meets all the requirements for use as a navigation template.

The next step is to print the physical guide. This means that the data set for the navigation guide must be fed into the operating software of the 3D printer. This is done by positioning the data set(s) in the blank (a process called nesting). As support sprues are required for 3D printing, the automatic distribution proposal must be checked and corrected if necessary, so that the sprues are not positioned on the contact surfaces of the drill sleeves, which would make subsequent finishing difficult. After printing, the sprues are removed and the surgical guide is polished.

The navigation guide must then be inspected by the clinician for printing and finishing errors before the sleeves are finally

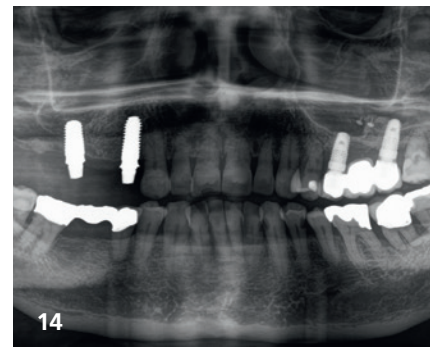
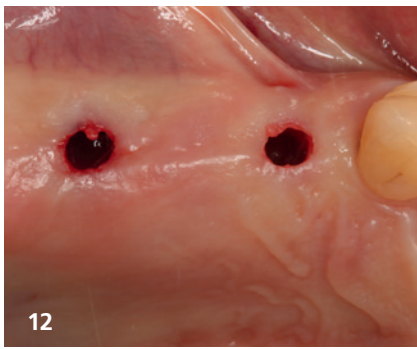


Fig. 12: Flapless preparation of the implant beds. **Fig. 13:** Placement of one-piece ceramic implants (whiteSKY, bredent medical) **Fig. 14:** Radiographic control of the implants before immediate restoration. **Fig. 15:** Restoration with splinted resin crowns. **Fig. 16:** Irritation-free healed ceramic implants before referral for prosthetic restoration.

fitted. If a sterilisable resin has been used, the guide can be sterilised. The device is now ready for use.⁸

Discussion

The navigation guides are used for various restorations in order to achieve optimal implant positioning for special treatment procedures. This makes immediate restorations more reliable and reduces the cost of subsequent fabrication at the laboratory.⁶

However, this advantage depends on intensive preparation, which today can increasingly be done digitally without involving an external laboratory. Especially when it comes to making optimal use of the remaining bone, deviations in the anatomical structures from the norm or unfavourable mucosal conditions, for example after extensive augmentation or soft-tissue surgery, make conventional orientation difficult.⁴

The ability to perform minimally invasive procedures with short, reduced-diameter or angulated implants also benefits from the use of a navigation guide.³ This includes immediate restoration techniques, especially with one-piece ceramic implants, as the temporary prosthesis can be prepared based on the drilling guide. These dental and chairside services should be itemised for documentation purposes and billed accordingly.



Author details



References



Contact address

Prof. Dr Jörg Neugebauer^{1,4,5}

Kerstin Salhoff²

Dr Steffen Kistler¹

Dr Frank Kistler¹

Prof. Dr Günter Dhom^{3,4}

neugebauer@implantate-landsberg.de
www.implantate-landsberg.de

¹ Dental offices of Dr Bayer and colleagues, Landsberg am Lech, Germany

² Dental billing office For Dent by Kerstin Salhoff, Nürnberg, Germany

³ Dental offices of Prof. Dhom and colleagues, Ludwigshafen am Rhein, Germany

⁴ Steinbeis University, Berlin, Transfer Institute for the Management of Dental and Oral Medicine, Ludwigshafen am Rhein, Germany

⁵ Interdisciplinary Policlinic for Oral Surgery and Implantology and Department of Oral and Maxillofacial Plastic Surgery, University of Cologne, Germany