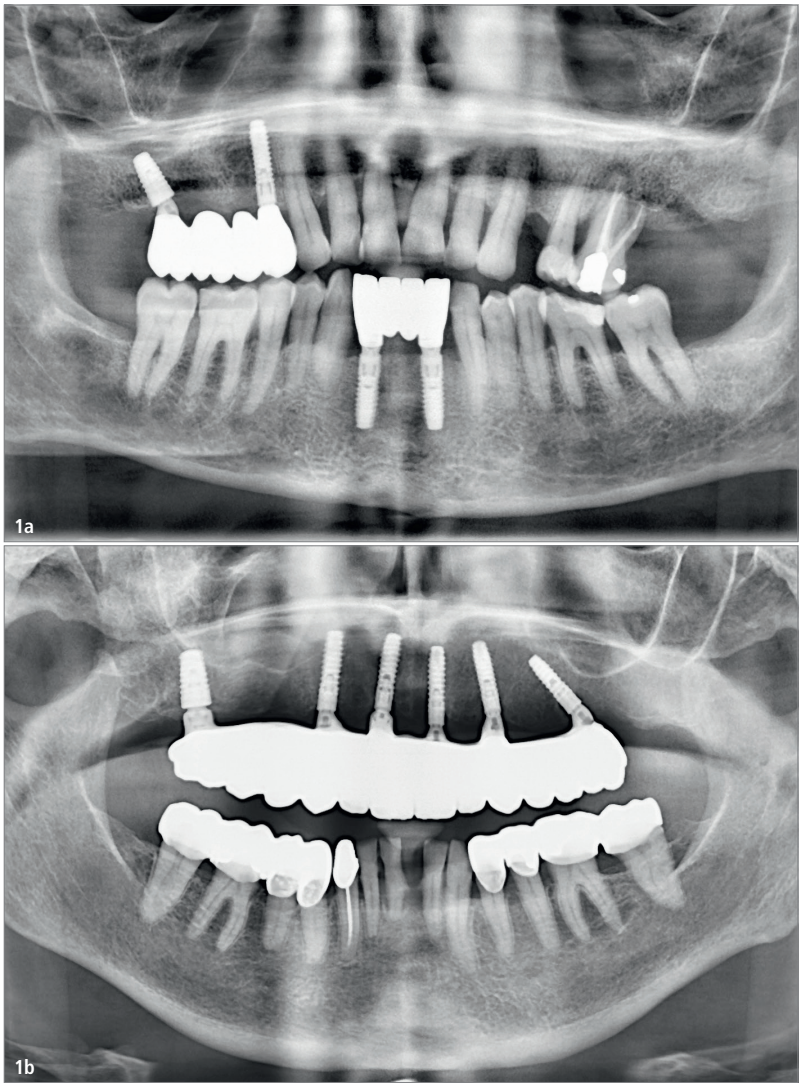
Nowadays, more and more implants are being placed at sites that would be considered as having insufficient bone volume for classical implantation procedures. The problem of the lack of bone volume is often solved by augmentation procedures, and, ever more frequently by the use of cell therapy, such as the combination of augmentation with platelet concentrates (PRF, PRGF, PRP). Another, increasingly popular solution is the use of existing bone with "tilted" implants.

Dr. Pavel Hyspler
[Infos zum Autor]

Literatur

Guided surgery in case of low bone volume

Dr. Pavel Hyspler



1a

1b

With mesiodistally tilted implants, could be often avoided the problematic structures, such as the mental foramen or the maxillary sinus, for example through the "All-on-4" concept. An often neglected option is vestibulo-oral deviation of the implant. In anatomically suitable patients, this can significantly simplify the treatment and shorten the treatment time. In the maxilla, the most frequently performed type of implant insertion procedure is one in the thick wall of the maxillary sinus, possibly using guided implant placement, in unusual bone structures that may arise, for example, during bone healing of periapical granuloma. In the mandible, placing an implant of this type is most commonly performed to avoid the mandibular canal and without the need to perform vertical bone augmentation (Figs. 1a and 1b).

Comparable long-term success rates of tilted implants, compared to implants in the tooth axis, have been repeatedly published in the results of meta-analyses. Some studies show a somewhat reduced success rate in the maxilla.1 They all agree, however, that

Figs. 1a and b: By using tilted implants, the existing bone can be used without the need for bone augmentation.

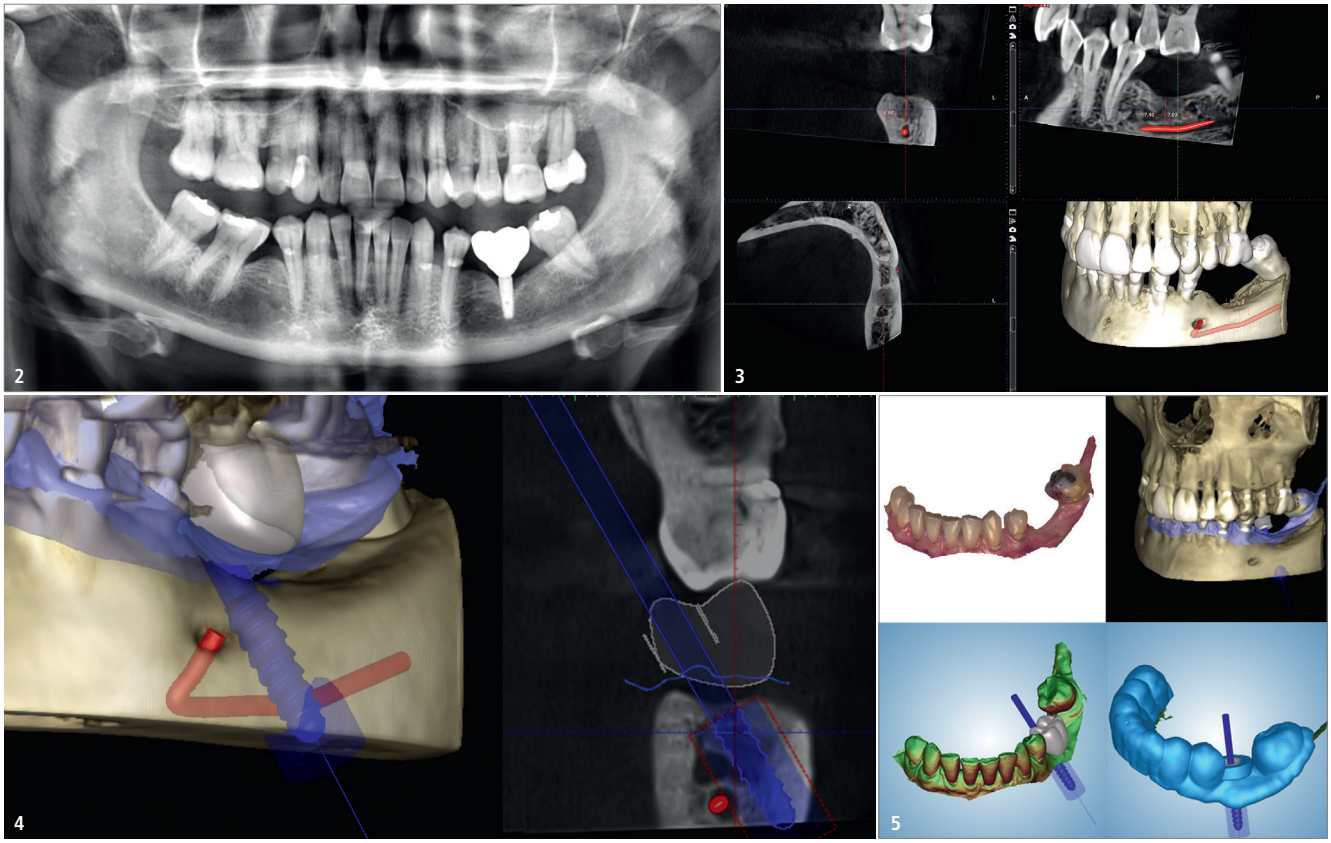


Fig. 2: Initial radiograph before the start of treatment. – **Fig. 3:** CBCT scan three months after implant removal. – **Fig. 4:** Planned position of the BioniQ® implant near the mandibular canal. – **Fig. 5:** Design of a surgical template in the Romexis program, taking into account the requirements for implant position as well as a suitable restoration.

the short-term, as well as long-term success rate is higher for tilted implants than for implants inserted in bone grafts.2 The disadvantage of tilted implants is that they have a significantly higher prosthetic complexity.

The successful use of tilted implants places high demands on the planning of future prosthetics and on the accuracy of implant placement. Advantageously, a fully digital workflow with guided implantation can be used. In most case reports, the fully guided surgery has been shown to be more accurate than guided pilot drilling.5. The accuracy of fully guided surgery – in the case of supporting a surgical template on the teeth on both sides of the osteotomy for the implant – is even sufficient for safe implant placement, even in the vicinity of anatomically risky structures.6 The following clinical case shows an alternative treatment method for a small vertical bone volume in the mandible.

Clinical case

A 52-year-old patient sought help at our clinic due to problems with her implant at the site of tooth 36, which had been placed at another practice about 6 years previously. There appeared to be implant loosening. On the OPG (ProMax, Planmeca), a large bone loss was visible around the implant caused by peri-implantitis (Fig. 2). The implant was, therefore, removed and the defect was excochleated. After three months, a CBCT image (ProMax, Planmeca) was taken for planning a new implant supported restoration (Fig. 3). After considering all options (vertical augmentation, short implant), a tilted implant was selected, which was inserted so that it passed the course of the mandibular canal (Fig. 4). The CBCT scan helped to determine the position of the mandibular canal more precisely. The appropriate diameter and length of the implant were then selected in the software. The implant position was determined so that the implant would pass the canal course and at the same time take into account the current bone availability. It is very important to look at the situation from different points of view to make sure that the treatment has been planned properly.

An intraoral scan of the mandible was made using the intraoral scanner (3Shape). This model was first converted into STL format and then imported into the Romexis software (Planmeca).

Converting to STL format makes it possible to continue working with the images and to superimpose the images of soft and bone tissues. This makes it possible to analyse the actual situation more precisely and in more detail. Planning a surgical treatment with regard to the optimal prosthetic result is easier, more pleasant and more efficient thanks to these possibilities.

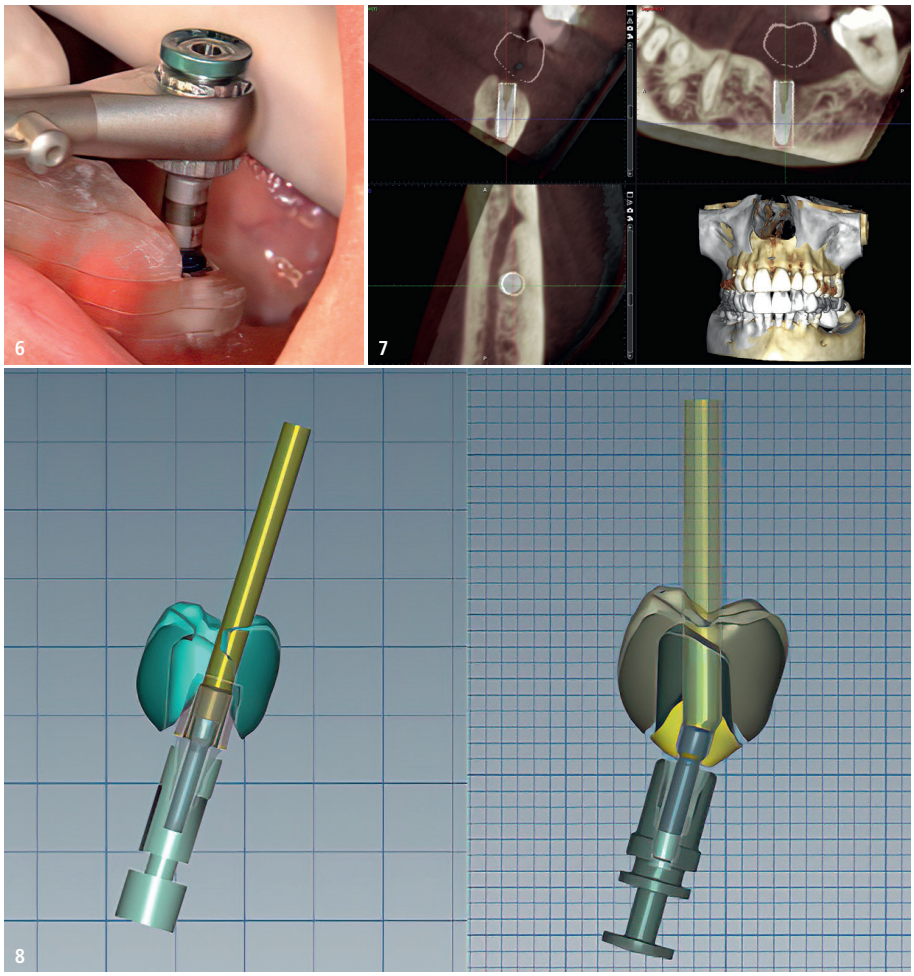
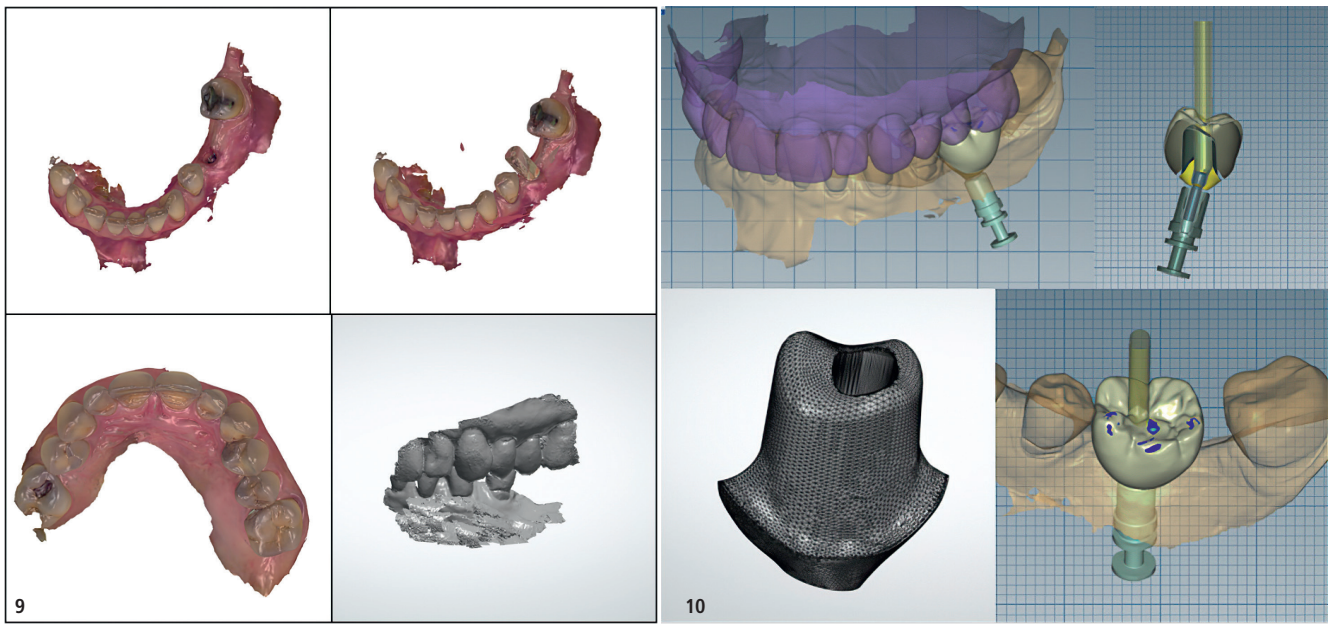
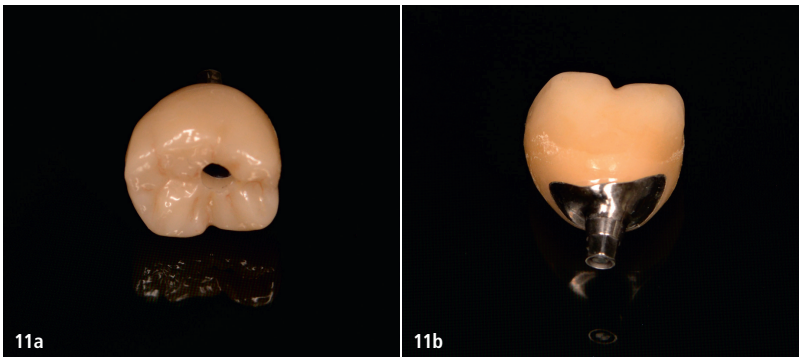


Fig. 6: Insertion of the BioniQ® implant through a surgical template using an insertion wrench with marked offsets. – **Fig. 7:** Accuracy of template guided implantation – the planned position is represented by a white cylinder. The implant was inserted according to plan with a clinically insignificant deviation. – **Fig. 8:** Instead of a titanium base for straight screw access channel (left figure), a custom abutment with better accessibility to the screw channel of the restoration was fabricated (right figure). – **Fig. 9:** The emergence profile of the mandible, scan of the mandible with scanbody, intraoral scan of the maxilla, and occlusion scan. – **Fig. 10:** Design of the individual abutment and the dental crown in the exocad program.

The insertion of a BioniQ® implant with a diameter of 3.5 mm and a length of 12 mm was planned. The LASAK surgical template for guided surgery (BioniQ®, LASAK) was created in the Romexis program with the following settings (Fig. 5): Thickness: 2 mm, Gap to Teeth: 0.13 mm, Gap to Sleeve: 0 mm. It was printed from NextDent SG material on the Original Prusa SL1 3D printer (Prusa Research). A guide sleeve (Steco, model M.27.15. D520) was glued into the surgical template. The instrument set for BioniQ® guided surgery allows two distances of the guide sleeve for the implant length of 12 mm – 2 mm or 6 mm. In the case presented here, a larger distance was chosen due to the thickness of the soft tissue.

After the administration of a mandibular anaesthesia with 2 ml articaine hydrochloride 40 mg/ml and with epinephrine 5µg/ml, a surgical template was put into position. For implants with a diameter of 3.5 mm or 4.0 mm, the standard procedure in the clinic is not to remove the tissue above the osteotomy for the implant with a trephine. So the drill guide for the drill (S2.9/2.3 mm, LASAK) was inserted into the guide sleeve. A pilot osteotomy was performed using the drill guide and using the long S2.9 drill. A drill guide (S3.5/d2.95, LASAK) was then inserted and the final osteotomy was performed using the S3.5 long drill. The adjustment of the cortical bone was



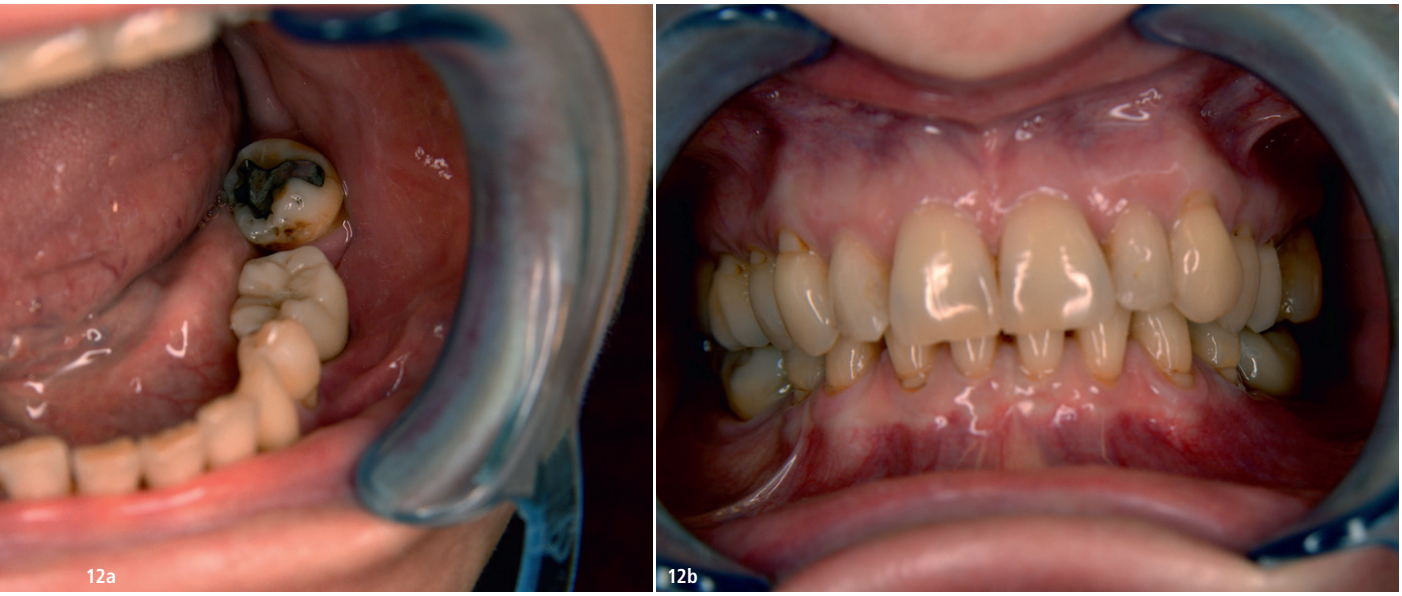


Figs. 11a and b: Final dental prosthesis.

carried out with the S3.5 countersink guided with a C-guide for offset H10. The implant (BioniQ® S3.5/L12, LASAK) was then inserted using the insertion wrench and ratchet. The laser markings on the insertion wrench are calibrated to the upper edge of the Steco guide sleeve (Fig. 6).
After insertion, a control CBCT scan was taken and compared with the planning CBCT scan. The planned position is marked by a white cylinder (Fig. 7). The implant was inserted according to plan with a clinically insignificant deviation. The time devoted to planning, combined with the high quality instrumentation and precisely printed surgical template, allowed for a quick procedure with a predictable outcome.

Final dental prosthesis

After three months, the fabrication of the restoration was started. Two possible solutions can be proposed for similar cases: Firstly, the use of a standard titanium base for straight or angled screw channel restorations. If the screw channel does not open out at an aesthetically exposed point, the non-angled screw channel solution is preferred. In this case, the screw access channel would open onto the lingual surface.
The second solution method is to make an individual abutment and use a hexagonal screwdriver with the possibility of deviating the screwdriver axis from the fixing screw axis. In this case, the second option was chosen (Fig. 8).
A scan of the maxilla, the emergence profile of the mandible, a scan of the mandible with scanbody and an occlusion scan (Fig. 9) were each taken with the intraoral scanner.
These scans were then exported into open STL files. The design of the model was performed in the program (exocad, Fig. 10). The use of an intraoral scanner is much more comfortable for the patient than using the conventional method of impression taking. Thanks to improvements in and the increased precision of intraoral scanners in recent years, digital technology is also preferred by dental technicians at the clinic due to its greater comfort and higher speed.
The custom abutment (Copra-Ti-5 Titanium Grade 5, Whitepeaks Dental Solutions) and the zircon crown (Zolid HT+ White, re-coloured with Ceramill® liquid FX with glaze Ceramill® Stain & glaze, Aman Girbach) were fabricated on a CNC milling machine. The custom abutment was bonded into the zirconia crown in the laboratory. The finished denture is shown in Figure 11. This procedure is chosen to minimise the risk of inflammation around the implant due to excess cement, but also because of the greater flexibility it allows for achieving the desired aesthetic result. Possible complications are thus avoided and the number of ses-



Figs. 12a and b: The final result after placing the dental crown at the site of tooth 36.

sions reduced. Furthermore, given the nature of tilted implants, which are more prone to prosthetic failure at the abutment level, this solution offers better options for possible revision of the prosthesis.

After removing the healing abutment, the crown was placed and the fixing screw was tightened to 25 Ncm. The screw access channel was closed with composite. The result after insertion of the denture can be seen in Figure 12. Both occlusion and articulation were checked. Finally, the patient was discharged for regular recalls.

Summary

This case shows an alternative approach to solving tooth loss by using an implant with a fully digital workflow. The effective integration of digital technologies not only allows future restorations to be planned with a high degree of accuracy, but also makes the placement of implants using guided surgery more precise in a significant way. A major benefit of patient virtualisation and virtual planning of the restoration is the reduction in the frequency of "prosthetic surprises", i.e. cases in which the incorrect implant position is only determined after beginning fabrication of the prosthetic restoration. Treatment time and the number of treatment sessions are significantly reduced.

The promising future of guided or dynamic computer-assisted implantation is also shown by the 2019 study conducted by Sanz et al., in which 138 experts from all over the world were questioned about the future of implantology. The question "Do you believe in the future implant placement will be mainly", was answered by 92% of those questioned as guide oriented implant placement (84%) or fully guided procedures (8%).

Virtualisation and guided surgery often reduce the invasiveness, and thus the risk of the procedure in a significant way. In this case, it was a "flapless" implantation compared to a much more invasive, risky and expensive vertical augmentation. These procedures often shorten the duration of treatment, usually by three to six months. Ultimately, more and more comfort is achieved – by shortening the treatment time, reducing the number of sessions, replacing conventional impression taking – and thus increasing patient satisfaction. As the prices of instrument sets for guided surgery, for the necessary programs and 3D printing decrease, in most cases there is also an economic benefit for both the dentist and the patient.

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