

# Navigation and Augmentation: Enhanced Possibilities for the Application of Guided Surgery

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Beside complete systems for the direct navigation (eg, Robodent, VoNaviX, LapDoc, etc.), recently there have been systems developed that enable the surgeon to insert implants guided by a surgical template, thus like indirect navigation. The positioning of the implants is thereby done by analysing a three-dimensional reconstruction of the bone on the basis of a DICOM data set on a usual computer.<sup>1</sup> Afterwards, either the virtual planning is transferred to a conventional template via a coordinates-table (CoDiagnostiX, Med3D) or a stereolithographical template is fabricated directly out of the virtual data (Simplant, NobelGuide), which is more accurate.<sup>2</sup>

Depending on the technique used, at least the pilot-drill is guided (CoDiagnostiX, Simplant Surgiguide) or—via a system of sleeves in combination with specially designed burs equipped with a long shank—the whole preparation and even the insertion is guided by the surgical template (Simplant Safe System, NobelGuide). Using NobelGuide the system furthermore allows one to place guided sleeves for so-called anchor pins (Fig. 1), which stabilise the template on the bone.

In view of the increased costs and radiation exposure, even if modern equipment is used, the application of such techniques is not indicated in any case.

The advantage of a higher planning reliability regarding sensitive anatomical structures, as well as the increased patient comfort caused by the reduced time of intervention and a less traumatic

approach can, nevertheless, for patient and surgeon make the procedure favourable. The option to produce a functional prosthetic suprastructure on the basis of the planning and the immediate post-op incorporation of it especially opens new concepts in therapy. Immediate loading of dental implants in the meantime is well documented, at least for implants with modern surfaces.<sup>3,4</sup>

## Sinus grafting through the template (Summers Approach)

Such planning techniques are particularly applicable with good hard tissue dimensions and in these cases they really provide minimal invasive surgery. The following case exemplarily demonstrates the transgingival insertion of six implants in the upper jaw via a NobelGuide template (Figs. 2–5).

As immediate loading is an option, which produces additional costs, some patients prefer to wait conventionally for a three-month period of osseointegration. In this case, finally a screw-retained ProCera Implant Bridge<sup>5,6</sup> was incorporated. Therefore a lab-designed resin frame is scanned, milled out of a titanium block with an accuracy of only 5 µm and faced with composite (Figs. 6, 7). Unfortunately, ideal bone premises are found rather rarely, especially considering the fact, that today the implant position is more and more driven by the prosthetic requirements.<sup>7</sup>

In most cases, invasive bone augmentation is unavoidable and, according to the common opin-



Fig. 1

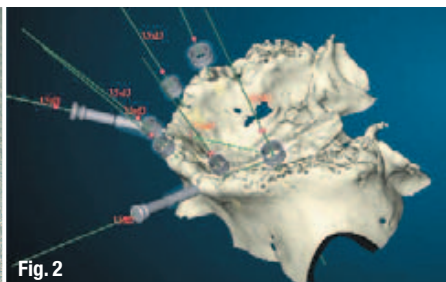


Fig. 2



Fig. 3



ion, thereby excludes the application of guided implantology. Doubtlessly, a bone-supported template does not allow an increase of the bone volume below itself. On the other side, a gingival-supported template needs an intact gingiva and does not allow the building of a flap.

A sinus grafting with a crestal approach<sup>8,9</sup>, can be done flapless with particular precision via a CT-based template as the amount of subantral bone can be exactly measured and the depth of the pilot drill can be adjusted. Even the fracturing of the sinus floor with a suitable dull osteotome can be done through the template (Fig. 8).

Additionally, knowing the exact amount of the grafting volume increases not only the predictability of the procedure but, moreover, facilitates the finding of the indication for the procedure.

### Alveolar ridge augmentation below the template

Usually severe bone atrophy is found after loss of teeth that occurred in the past or non-disposition of teeth (Fig. 9). As long as the remaining bone allows simultaneous implantation, the template does not obstruct alveolar ridge augmentation below itself.

The following case shows an augmentation with a mixture of autogenous bone chips and alloplastic material covered by a collagen membrane (Figs. 10–12). The NobelGuide template was safely supported by the remaining teeth.

As the position of the implant was well-known preoperatively because of the virtual planning, an immediate provisionalization with a resin crown was possible (Fig. 13). Three months later the definite Procera Abutment<sup>10</sup> and Procera Crown<sup>11</sup> were incorporated (Fig. 14).

### Sinus grafting below the template (Tatum Approach/avoiding augmentation)

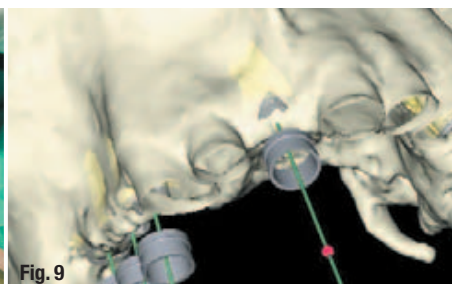
The NobelGuide System puts into effect a combination of gingival support and bony support via the pluggable Anchor Pins. In many cases, therefore, a surgery with a flap as well as a limited addition to the hard tissue volume under the template can be done.

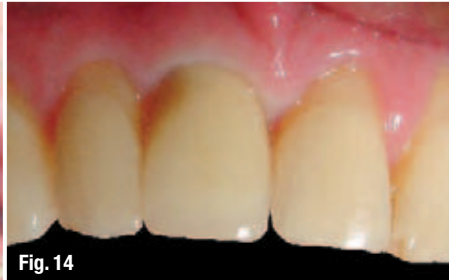
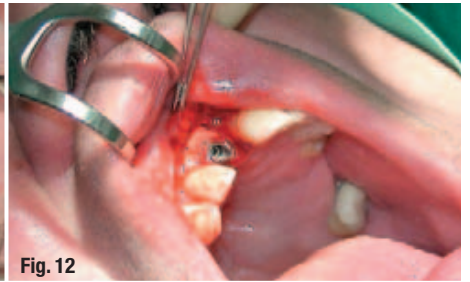
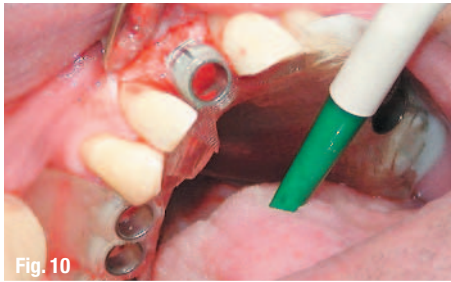
Initially the template is only gingivally supported and stabilised with a silicon bite. This turns into a bony support as soon as the Anchor Pins with their diameter of 1.5 mm and a penetration depth of 5 mm are applied. Because of the pluggable design of the pins, the template can be taken out and repositioned exactly anytime during surgery. As soon as the anchor pins are set, the gingival support is not necessary anymore and surgical flaps can be done. Moreover, the resulting gap between the "pending template" and the denuded bone gives some space for bone manipulation including, for example, bone spreading.

As the next case shows, a bilateral sinus grafting can be done and the implants can be inserted through the repositioned surgical template into the graft (Figs. 15, 16). Just as well as in the above described crestal approach, the exact three-dimensional measurement of the graft improves the reliability of the procedure (Fig. 17).

Severe atrophic situations in the lateral lower jaw are often very difficult to handle. The riskless angulation of implants—as it is possible using a CT-based template in elected cases—renders the sometimes complex augmentation of these areas unnecessary (Figs. 18, 19).

The angulation of the implant (region 35 – FDI) gives prosthetic support for a full-arch bridge even in the molar region. Non-axial forces applied to angulated implants do not seem to compromise the





implant-bone interface or increase peri-implant bone loss.<sup>12</sup> Preliminarily, two resin bridges with metal reinforcements were built by the technician and immediately inserted postoperatively.

Even using the most sophisticated planning technique does not avoid a deviation between planning and surgical realisation. This tolerance with Nobel-Guide is about 0.2 to 0.5 mm and requires the compensation by special abutments (guided abutments, Figs. 20–22) to enable a screw-retained provisionalization. Not included in the immediate loading are the two implants located in the sinus graft.

### Summing-up

In sufficient hard-tissue situations, CT-based drilling templates are not only able to increase the reliability and forensic documentation of the surgery but also the positioning of the implants concerning esthetics and balanced load. Moreover, the surgeon

can decide the indication for augmentation in proper cases restrictively.

Last but not least, modern techniques and patient comfort are very potent elements of marketing for the surgeon.

*The literature list can be requested from the author.*

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