Dynamic guided surgery: the next chapter

Implant placement using real time navigation

Computer-aided planning, design and treatment techniques are advancing at an exponential rate, as are their applications in healthcare. Dentistry, and in particular, osseointegrated implants and implant restorations are also following this trajectory.

Stereolithographic surgical guides are currently considered to be the gold standard for guided surgery. Stereolithographic guides are fabricated using data from CBCT scans and prosthetic planning carried out prior to surgery. These guides do not, however, allow for any adjustments to be made in the surgical stage. This is due to the fact that the surgical drill holes are at fixed locations in the stereolithographic template and cannot be adjusted intra-operatively; such guides are therefore termed 'static'.

It is currently possible to create 3D scans of the patient's facial structure, which surgeons can then use to plan and practise procedures, and review predicted results digitally before undertaking long and/or difficult surgical procedures.

With the development of increasingly sensitive optical cameras, and advancing software, the next generation of guided surgery application is now available. The Navident (ClaroNav, Toronto, Canada) surgical navigation system utilises CBCT images, but differs fundamentally from previous systems in that it allows for the guidance of osteotomy and implant placement to be navigated in real time. It does this by means of an optical tracker and tag system that can be shown on a computer monitor. The main advantage of this type of guided surgery is that the aforementioned limitations of static guides can be avoided. This article presents two case studies illustrating the use of this next-generation guided surgery in practice.

Case 1

The patient came to the clinic with a request for a fixed solution after functioning with a partial removable prosthesis for about one year. This was provided following the failure of a conventional bridge after 33 years. He requested a fixed solution as the nature of his profession would not allow him to be edentulous.

A complete periodontal, dental and functional examination was carried out, and the proposed treatment plan was accepted. A conservative approach was taken in the mandible, with composite built up to restore the occlusal table. It was decided that implant therapy and the removal of the remaining periodontally compromised teeth would be required in the maxilla. For the purpose of this case study, only the treatment steps for the maxilla will be demonstrated. With clinical parameters considered and the patient's wishes respected, the following preparations were carried out for simultaneous flapless implant placement followed by immediate loading:

1. The surgical guide (NaviStent, ClaroNav, Toronto, Canada) was made chair-side by the surgeon. This was done by moulding the thermoplastic tray to the patient's specific anatomy. A window was created for access to the surgical site (Figures 1.3, 1.4)
2. A planning CBCT (Planmeca Promax 3D MaxTM (Planmeca, Illinios, USA) was made with the Navistent in the mouth (Figure 1.5)
3. The patient was anaesthetised
4. The surgeon performed surgical planning with the Navident planning software (ClaroNav, Toronto, Canada). This was then verified by the assistant surgeon
5. The guide was once again secured in the mouth and connected to the jaw tag optical tracker
6. The drill tag optical tracker was connected to the surgical hand-piece, and the two trackers were calibrated by means of a central stereo camera
7. The surgery commenced, and the surgeon was able to use the computer screen to follow a digital representation of the surgical field (Figure 1.10)
8. The assistant followed the surgery by looking directly at the surgical field itself
9. Conventional commercially available surgical sets and implants were used (Dentsply, Astra EV in this case)

Top, Figure 1.1: Pre-operative frontal view. Middle, Figure 1.2: Pre-operative OPT. Left, Figure 1.14: Three-month post-operative view of immediate loaded bridge.

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Figure 1.3: Navistent seated intraorally.

Figure 1.4: Access opening to surgical site.

Figure 1.5: Conventional CBCT with scanning markers in position.

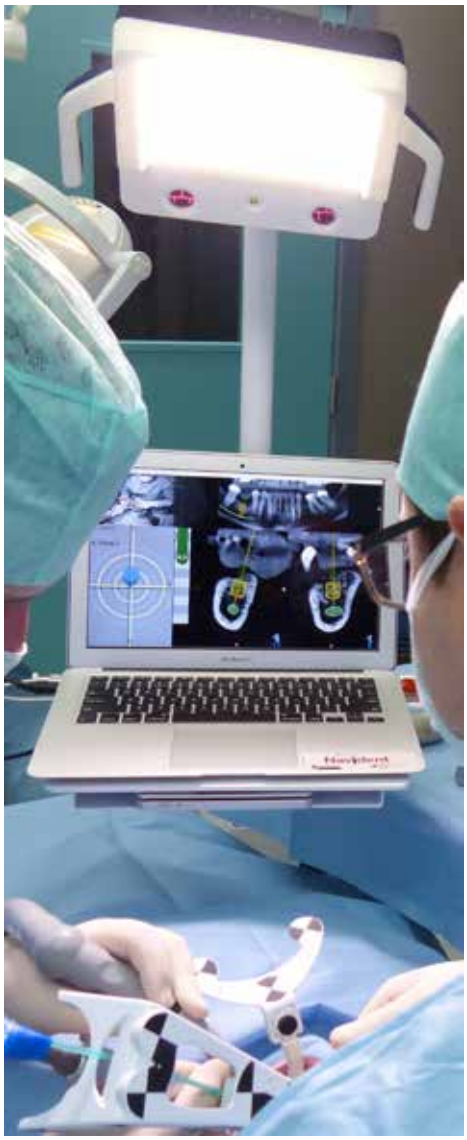

Figure 1.10: Overviewing stereo camera.

Figure 2.1: Frontal view.

Figure 2.3: Ridge dimension maxillary occlusal view.

Figure 2.5: Osteotomy preparation completed.

Figure 2.6: Flapless implant installation with healing abutment in position.

Figure 2.8: Post-operative frontal view with temporary crown.

Case 2

The patient presented at the clinic asking for a fixed solution; his sole request was that his original maxillary midline diastema be re-established when the final restoration was placed. The patient's treatment history included various treatments over a six-month period after an earlier blunt-force trauma to the 21 and 22. The patient presented with a partial prosthesis to replace the missing 21 and had received endodontic treatment to the 22.

Due to the fact that the patient had a healthy dentition, and taking into account his primary request for an open diastema, a single implant was indicated. Due to bone volume, medical history and aesthetic demands, this case was selected as an ideal candidate for flapless guided implant placement. The same series of nine steps as described above was carried out during surgery.

Conclusion

The Navident surgical navigation system has been used in various applications. The same protocol can be used for the maxilla or mandible, and in the anterior or posterior region. It is compatible with both a flap or flapless approach. Slight alterations are necessary in an edentulous maxilla or mandible. The system is particularly helpful in difficult and/or compromised cases.

There are various ongoing research projects relating to this system and its applications. More evidence is required before the system can be considered the new gold standard. It is important to note that, as with any advanced technological treatment, the system is sensitive to technique, and there is a steep learning curve involved in its clinical application. Following the prescribed product orientation and master clinician courses is strongly advised.

View the full set of figures for both cases at eao.org/inspyred