

Flapless implant placement with an internal sinus lift using dynamic guided navigation

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Fig. 1_ The Navident system is shown here with the Micron Tracker and laptop loaded with the Navident software.

(Photos/Provided by Dr. Naheed Mohamed and ClaroNav Inc.)

Today, implant surgery is focused on being minimally invasive with an emphasis on prosthetically guided implant placement.¹ Implants that are not placed in a prosthetically favorable position are at risk for future complications involving the prosthetic components or peri-implant tissues.² Successful implant placement is not only judged by osseointegration but also the esthetics. In a climate where implant therapy is held to the highest of standards, using advanced tools to simplify surgical dental implant placement is a requisite for success.

Currently computer-guided surgery involves the use of a CBCT (cone-beam computer tomography) scan and possibly an intra-oral scan to allow personalized digital surgical planning. This plan is then transferred to the patient in the form of surgical guides to aid in accurate implant placement. These guides, however, are static and do have some drawbacks. They are not always stable depending on whether they are supported by teeth, mucosa or bone. Limited mouth opening does become an issue when surgical guides are used to place implants for posterior dentition.³ And, lastly, if there is any error in the digital planning, segmentation of the anatomy or data transfer to the guide fabrication, the error is passed down onto the guide's implant position.⁴ If errors are noted during surgery, then the guide essentially becomes useless.

The next evolution in guided dental implant surgery comes from neurosurgery and orthopedic spine surgery, where it has been used for quite some time. ClaroNav Inc., has developed a live navigation system using optical tracking cameras (Fig. 1) during implant surgery to provide the surgeon with CBCT-based

real-time three-dimensional drill guidance during implant surgery. One of the main advantages of this Navident system is that dynamic navigation allows intra-operative changes to implant position in real time if any errors or anatomical complexities are noted during the surgery.⁵ The flexibility of having a guided implant placement in a digitally planned ideal location without the need for a static surgical stent and having the osteotomies live navigated on CBCT data using optical tracking is a game changer for implant dentistry. This open system also has the flexibility of using any implant system and any drill to guide placement. The case presented below showcases the flexibility of real-time navigation where Straumann implant drills are used for placement of an implant with a simultaneous internal sinus lift using the Hiossen CAS-KIT drills with the Navident system.

_Case report

The patient was a 57-year-old healthy female who was referred to our clinic to replace the missing maxillary second premolar at the 2.5(13) site with a dental implant. The Navident workflow consists of four main sequential steps: stent fabrication, CT (computer-tomography) scan with the stent and affixed CT marker in the patient's mouth, digitally planning the implant surgery in the Navident software and, lastly, completing the live guided implant surgery. One of the biggest advantages of the Navident system is that these four sequential steps can all be completed in one appointment, provided the clinic has an available CBCT scanner.

The NaviStent functions as a retainer onto which the CT marker is affixed to while the patient undergoes her CBCT scan. The NaviStent is a custom single-use retainer made of a thermoplastic material called Naviplast then can be heated in hot water and molded to the patient's dentition. The stent was trimmed, and the planned implant site was cut open to expose

Fig. 2_ A screenshot from the Navident software showing the digitally planned crown and implant (yellow) placement.

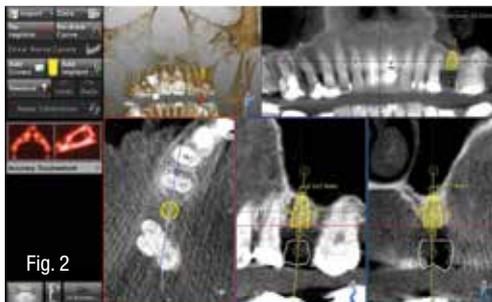


Fig. 3_ The drill is shown here being calibrated on the JawTag, which is fixated to the NaviStent in the patient's mouth.



Fig. 4_ The clinical view of the handpiece being used to drill the osteotomy as it is being guided on the monitor. Note the DrillTag shown above attached to the surgical handpiece that allows it to be tracked.

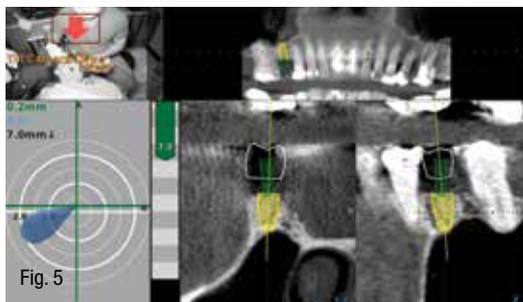


Fig. 5_ A screenshot showing the Navident software navigating screen while the drill (in green) is being live guided against the CBCT cross sections. The CBCT cross-sectional views as well as the target bull's eye on the left allow the surgeon to navigate the drill to the ideal digitally planned position.

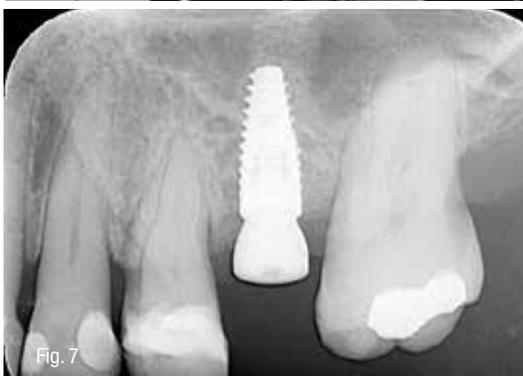


Fig. 6_ An immediate postoperative clinical view of the surgical implant site, showing the flapless surgery of the single-stage implant-guided placement with a healing abutment.

Fig. 7_ Postoperative peri-apical radiograph showing a Straumann Bone Level Tapered SLActive Roxolid 4.1 mm x 10 mm implant placed with an internal sinus elevation.

the ridge. The CT marker was then fixed to the stent by way of a thumb screw. The NaviStent with the attached CT marker was placed into the patient's mouth. The stent was checked for stability in the patient's mouth. A CBCT scan was completed for the entire maxillary arch, being sure to include the arm of the CT marker, which contains the aluminum fiducial.

The CBCT scan was then imported into Navident software. The Navident software automatically registers the fiducial and asks you to inspect the registration to ensure there is no malalignment. Our implant position is prosthetically determined, so our first step was to place a virtual crown at the 2.5 (13) site. The vertical height of bone from the ridge to the sinus floor was measured using the software measuring tool and found to be 7.4 mm (Fig. 2).

Our treatment plan involved placing a Straumann Bone Level Tapered SLActive Roxolid 4.1 mm x 10 mm implant as a single-stage flapless approach with an internal sinus elevation. Taking advantage of the freedom of the Navident system, we were able to plan our surgery to place a Straumann dental implant and complete our internal sinus lift using the HIOSSEN CAS-KIT (Crestal Approach Sinus Kit). To control our

drilling depth and use the live navigation to guide us to the sinus, a digital implant was placed in the ideal location with respect to the digital crown. This digital plan would guide us to the sinus floor for the sinus elevation and allow ideal implant placement.

_Live navigation implant surgery and internal sinus elevation

The patient was seated for the implant surgery. Local anesthetic was given. The single-use JawTag was fixated to the NaviStent with the provided thumb screw. The tag adapter was mounted onto the surgical handpiece and fastened in place, according to the company's instructions. The single-use DrillTag was attached to the tag adapter on the surgical handpiece. The NaviStent was placed into the patient's mouth with the JawTag visible for the Navident camera to detect.

Once the CT markers are visible by the camera, they become visible on the side panel on the monitor. The next step was to calibrate the drill axis by placing the handpiece head onto the calibration peg present on top of the JawTag. The handpiece was

then rotated back and forth around the peg to register and calibrate the drill axis. The system then prompts us to calibrate the drill. The initial precision point drill was then placed onto the handpiece and calibrated by placing the drill tip into the dimple present at the center of the target on the JawTag (Fig. 3). Once the drill tip was calibrated, it then became visible on the monitor against the CT image when it is placed into the surgical field.

Our next step was to verify the drill tip position. This was done easily by placing the tip of the bur on a landmark in the jaw to verify accuracy of its positioning. In our case, the tip of the drill was verified by placing it on the cusp tip of the neighboring tooth 2.4 (13). The drill was then brought to the surgical site (Fig. 4), and the navigated drilling screen comes up, which shows a target view and cross-sectional views of the CT images with the drill image visualized in its real-time position (Fig. 5). The target and cross-sectional views allow you to position the drill into the ideal digitally planned implant position based on the live view of the drill over the CT images.

The drilling process was started with a precision drill to punch a dimple into the bone and give us a soft-tissue bleeding point. The bleeding point was then used as a marker to remove a 4 mm diameter of crestal gingiva with a tissue punch. The Straumann pilot drill was then calibrated and verified on the handpiece. The 2.2 mm pilot drill was then used to drill at 800 rpm to about 7 mm into the osteotomy using the live navigation to guide us into the digitally planned position. The second 2.8 mm drill in the Straumann Bone Level Tapered implant protocol was calibrated, verified and live navigated to the desired position at a depth of 7 mm into the osteotomy.

The drills were now switched to the Hiossen CAS-KIT drills to allow removal of the cortical bone at the floor of the sinus without damaging the Schneiderian membrane. The CAS-Drill tip has an inverse conical shape that forms conical bone chip as it drills to allow it to safely elevate the sinus membrane without perforating it.

The bone particles formed when drilling discharge upward producing a membrane auto-lift function. The Hiossen CAS 3.3 mm drill was used with an 8 mm stopper as a backup to prevent us from forcefully pushing too deep into the sinus. The CAS drill was calibrated and verified and then live navigated to access the sinus membrane.

Once the membrane was exposed through the osteotomy, it was elevated using hydraulic pressure with the CAS-Kit Membrane Lifter and sterile saline. Cortical allograft chips were then gently pushed into the void created from the membrane elevation. The jaw stent was removed, and the implant was placed through the osteotomy with direct vision. The Straumann Bone Level Tapered 4.1 mm x 10 mm implant was placed with 50 Ncm of primary stability. A healing abutment was then hand-torqued in place (Fig. 6).

A postoperative peri-apical radiograph (Fig. 7) was taken to assess the implant placement. The implant can also be live navigated into place; however, it needs to be calibrated by touching the tip of the implant over the JawTag dimple, and because of the risk of contamination, we chose to place it with direct vision. The company recommends placing a sterile piece of nylon over the dimple when calibrating the implant to keep the conditions sterile.

Because of the flapless live-guided Navident protocol, we were able to release the patient with no sutures required and minimal trauma to the site. The patient was prescribed anti-inflammatory analgesics and placed on a 7-day antibiotic course. Her healing was uneventful with minimal discomfort to the area.

Conclusion

Computer-guided placement of dental implants is significantly more accurate than free hand surgery.⁶ In areas of complex anatomy, computer-guided navigational surgery is superior to conventional implant surgery when it comes to preventing iatrogenic injuries.⁷ This technology can contribute to considerable improvement in quality and accuracy of dental implant placement.

The live real-time view of the exact position of the drill minimizes the potential risk of damage to critical anatomic structures.⁸ The optical tracking system seems to be more accurate and have more flexibility during surgery but does require more training to develop hand-eye coordination for using the system.⁹ However, once mastered, this new system can improve on accuracy of surgery, reduce surgeon anxiety, improve patient confidence and work as a powerful marketing tool for your practice.

References available upon request from the publisher.

about the author



Dr. Naheed Mohamed received his bachelor of science degree from the University of Toronto with honors. After a year of periodontal research at Mount Sinai Hospital, he attended dental school at Boston University and completed his doctor of dental medicine degree. Graduating from dental school magna cum laude and with the American Academy of Periodontology Dental Student of the Year Award for achievement in periodontics, Mohamed further pursued his studies at Case Western Reserve University in Cleveland to complete his specialty training in periodontics. During his residency, he pioneered research in an autologous blood-derived material called platelet-rich fibrin and its numerous clinical applications, earning his master's degree. Mohamed is a board-certified specialist in the United States and Canada, attaining his diplomate status by the American Board of Periodontology and fellow of the Royal College of Dentists of Canada. He currently maintains a private practice and actively lectures about innovations in periodontics and implant surgery.