Guided Implant Placement: What's New and When to Use?

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Q: When is guided implant placement *really* necessary?

A: Dr. Ganeles

Guided implant surgery offers a number of advantages for achieving the goals of accurate, safe, and predictable implant placement.[1,2] Despite these benefits, the use of guided implant surgery has remained rare. According to the 2014 iData report on the US implant dentistry market, fewer than 15,000 computer-generated surgical guides were purchased in 2012. This number is expected to double by 2019 to slightly more than 31,000.[3] Considering that more than 2.1 million dental implants were estimated to have been sold in 2012,[4] it is clear that only a small fraction of the implants are being placed using guided surgery.

So why is this modality not being used enough? Numerous answers can be considered, including a more time-consuming workflow; the need to purchase, learn software, and/or engage a third party to plan the case; the cost of the software and guide; the cost of special instrumentation to use the guide; the complications of using guides such as reduced irrigation and cooling to the drill; and access problems in the posterior dentition or tilted implants due to patient's limited opening ability.

Surgical navigation as a technology and a commercially available implant placement system has been available since 2002 in the United States. In the last year, two new systems have become available, and others are pending FDA approval. This technology might provide many of the answers to the limitations of surgical guides and increase the use of guided surgery in practice.

The surgical navigation devices in use and under development function as virtual guides for implant surgery.[5] The patient's cone-beam computed tomography (CBCT) scan is loaded into the software, and the implant is planned three dimensionally, ideally also incorporating the restorative plan. Instead of having a CAD/CAM guide produced, the camera-based navigation system is engaged and "sees" markers on the patient and handpiece. It instantaneously computes and displays the position of the implant drill relative to the planned position and previously stored CBCT data. The surgeon, who is watching a computer monitor rather than the patient's jaw, can virtually see the drill while operating and manually adjust its position to duplicate the preoperative plan. Navigation systems can compensate for patient movement and can also be instantly modified if anatomic variations are encountered or modifications to the plan are needed. When using navigation systems, routine drill cooling and irrigation are employed. Special handles, sleeves, or cumbersome intraoral stents are not needed, so access to posterior sites or tilted osteotomies is not impeded.

Navigation systems can be highly accurate.[6] However, one limitation is that they rely on the surgeon's eye-hand coordination and dexterity to convert data from the monitor into positional correction during the procedure.

The next technology beyond navigation for dental implant surgery is in development and involves robotics. With this system, planning and setup are similar to navigation. A robotic arm is attached to the drill. The surgeon moves the robotic arm, which provides visual, audio, and haptic (touch) feedback to position the handpiece/drill in the correct three-dimensional location. (The arm does not move independently.) The robotic arm allows the drill to be placed only in the predetermined position and depth, so that the osteotomy and implant are placed in the exact planned position. Deviations from the plan cannot occur unless the surgeon intentionally disengages the robot or overrides the plan.

An advantage of the robotic system over navigation is that it ensures accurate placement according to the preoperative plan, similar to the use of physical guides. It shares many of the positive characteristics of navigation over physical guides such as normal irrigation, lack of special instrumentation, and easier intraoral access in limited spaces.

As technology improves and becomes less expensive, the advantages of guided surgery are likely to become clearer and objections will diminish. A decade ago, only the busiest surgical practices could justify the expense of CBCT. A decade from now, dynamic navigation, whether visually guided or robotic, will be considered routine.

A: Dr. Orentlicher

When asked to respond to this question, my initial reaction was that some clinicians and academicians would say, "Never!" I don't fall into that category.

Although the rate of utilization of guided implant placement in my practice may be unusual compared with most (2015 statistics: 30% of patient cases, 52% of implants placed), the following is what I use as my indications for employing computed tomography-guided surgery:

- Three or more sequential implants
- Patient cases with anatomic and structural/bone volume issues

- Implant position critical to the planned restoration
- Problems related to proximity of adjacent teeth or implants
- Fully edentulous cases, with or without extractions and/or immediate loading
- Immediate extraction and implant placement (some patient cases)
- Significant alteration of bony anatomy (eg, trauma, grafting, distraction, pathology)
- Medical problems (eg, radiation therapy, blood dyscrasias, psychiatric, orthopedic)

Is guided implant placement "necessary" in all these situations? No. Dental implants have been successfully placed freehand, or nonguided, for decades. Dental laboratories have developed innovative solutions for inadequately positioned implants for generations. The reasons for guided implant placement are not to increase the implant cumulative survival rate, but to place implants more accurately according to a restoratively driven treatment plan. The technology workflow involves first planning the exact position and morphology of the planned restoration, then positioning and placing the implant according to that ideal. The concept is reverse engineering with accurate implant placement.

The rationale for guided implant placement comes down to two things: anatomy and accuracy.

Avoiding vital anatomy (eg, nerves, sinus, nasal cavity, tooth roots, adjacent implants) is a primary indication for guided-implant planning and placement. The ability to visualize surrounding anatomy, while planning the placement of a dental implant according to the ideal tooth position is a powerful tool. If using "fully guided" implant insertion instrumentation and techniques, the implant can then predictably be placed according to that plan.

The improved accuracy when using CT-guided surgery has been well documented in the literature. As with all technologies in medicine and dentistry, perfection is rarely achievable. Guided implant placement technologies are no different. Linear and angular deviations from planned positions are to be expected. But, those small deviations have been shown to be more accurate compared with freehand placement. In patient cases with limited bone volume; limited spacing between tooth roots or implants; distorted bony anatomy from grafting, trauma, or pathology; or cases in which proper implant positioning is critical to the esthetics of the planned restoration, CT-guided surgery will benefit the patient and the entire team (ie, restorative dentist, surgeon, and dental laboratory technician). The improved treatment outcomes will speak for themselves.

A: Dr. Wöhrle

While statistics regarding just how many clinicians are using guided implants are not available as of this writing, one can assume that a freehand approach to place implants is used most often. Observation indicates this method produces good results and, at times, even great results, but there is little indication this technique creates *consistently* great results.

In fact, the frequent use of custom abutments is an indication of non-ideal implant placement that has to be corrected prosthetically. When practicing the team approach, the surgeon may find it difficult to truly assess "ideal" implant placement. Indications of osseointegration and maintenance of crestal bone are musts, not signs of ideal implant placement. Quality of survival of the implant is determined by the overall harmony of hard and soft tissues and prosthetic reconstruction. Thus, the restorative dentist is the one who can best judge the implant location depending on the final prosthetic outcome.

Guided implant placement is not the standard of care but is rapidly becoming the standard for excellence in terms of safe and precise implant placement. It necessitates 3D radiographic datasets prior to treatment initiation. Although not technically considered a standard of care, most practitioners who are routinely placing dental implants have 3D imaging available and consistently use it.

Use of digital implant planning requires a series of steps, all of which are necessary in order to make a precise plan that will utilize surgical guides. Correct employment of virtual planning minimizes surgical risks, especially for less-experienced surgeons. Virtual surgery will always result in better understanding of patient-specific factors. If, during planning, an implant is placed too close to vital structures or adjacent teeth, or is impeding on other vital structures, the software alerts the surgeon of the problem and the implant can be repositioned to eliminate potential risk.

Use of digital planning also allows the dental team to visualize and approve the final prosthetic plan. The restoring dentist can tweak implant location and inclination prior to implant placement. Similarly, the dental laboratory technician can provide input and help avoid unseen planning pitfalls. Virtual planning allows for a "tryout" of various treatment approaches (implant-supported bridges vs several sequential implants, for example).

Once the digital workflow learning curve has been mastered, virtual planning and delivery via a template not only results in a better implant position when planned with prosthetic outcome, but also results in more efficiency when placing implants. As the field shifts toward screw-retained restorations for all applications, it's crucial for implant placement to have a preplanned exit through the preferred surface, either with proper alignment of the implant axis or with use of more advanced CAD/CAM techniques such as the angled screw channel. In partially edentulous cases in which the template rests on remaining teeth that have been scanned either by a model scanner or intraoral scanner, the accuracy of the template and its positioning have improved dramatically compared to soft-tissue or bone-supported templates.

Patients are intrigued and actually become excited when they can visualize their plans. Virtual planning allows patients to better understand their treatment options and risks by enabling them to visualize the intended results.

An ideal indication for utilizing guided implant surgery is implant placement using flapless surgery. This minimizes patient discomfort, decreases surgical time, and assures the implants are placed in the best restorative position. Clearly, using guided surgery with appropriate planning improves prosthetic outcomes and minimizes the possibility of patient injury.

The only times guided surgery is not indicated is in posterior sites that have limited access or are impossible to reach with the longer drills, or when the surgery needs to be performed before a guided template can be fabricated. Also, severely resorbed, totally edentulous ridges can lead to uncertainties of correct template positioning during surgery. In addition, certain grafted cases when using a guided drill that could split the graft from the host bed may pose a contraindication.

Digital implant planning and placement is here to stay because it delivers more efficient care with consistently better outcomes, especially in the partially edentulous patient. Placing an implant that is "restorable" is no longer a clinician's aspiration. With today's technology, one can hope to do better. Properly executed guided surgery combined with proper treatment planning elevates the level of excellence while increasing efficiency and safety.

DISCLOSURE

Jeffrey Ganeles, DMD, is a consultant for Noecis, Inc.

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