

From Our Office to Yours...

The introduction of computed tomography (CT) technologies and the rapidly increasing use of cone beam CT scanning (CBCT) in dental offices, combined with the use of dedicated dental implant software, has revolutionized the planning and placement of dental implants.

This revolutionary system offers a more accurate and safer positioning of dental implants, may reduce the time necessary for implant surgery, and may eliminate the need for flap surgery and bone grafts.

Furthermore, it facilitates a team approach toward a truly restoratively- and surgically-driven treatment plan.

This current issue of *The PerioDontaLetter* presents an overview of computer-guided technologies in dental implant placement, the benefits and drawbacks, indications and contraindications, complications and potential errors, and protocols.

As always, we welcome your comments and suggestions on this giant leap forward in implant surgery.

Guided Implant Surgery

Guided implant surgery is a procedure in which precision surgical instrumentation is used in conjunction with three-dimensional CT images. Dedicated computer software which allows visualization and manipulation of the

images of the patient's jaw bone and surrounding tissue makes possible the most accurate approach to implant surgery.

The images obtained by computerized tomography permit the implant surgeon to determine the height and width of

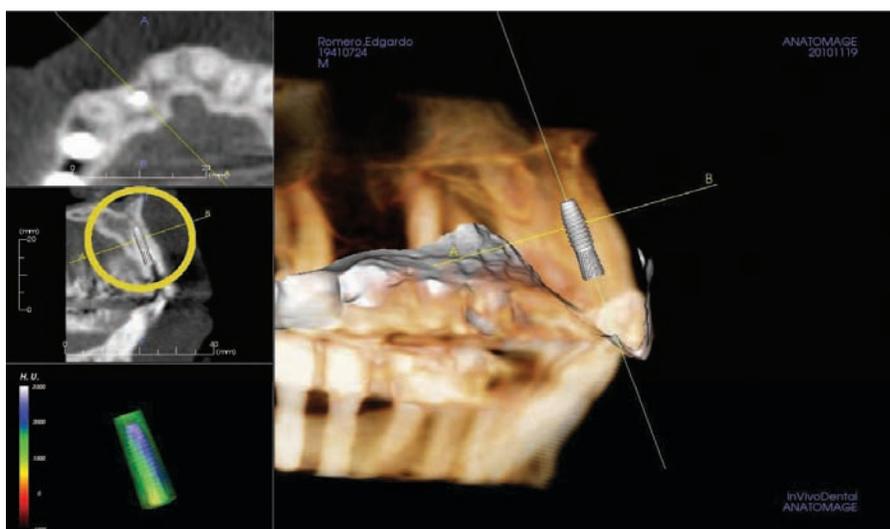


Figure 1. Guided surgery software allows the clinician to plan implant position by virtually placing implants in CT images scanned of the patient's jawbone.

available bone, soft-tissue thicknesses, the proximity and root anatomy of adjacent teeth, and other vital structures in 3-D. This enables the clinician to choose the correct implant size and position it appropriately in the arch.

Image-guided surgery was originally developed for neurosurgery and is now applied in many medical-dental treatments.

Benefits of Guided Implant Surgery

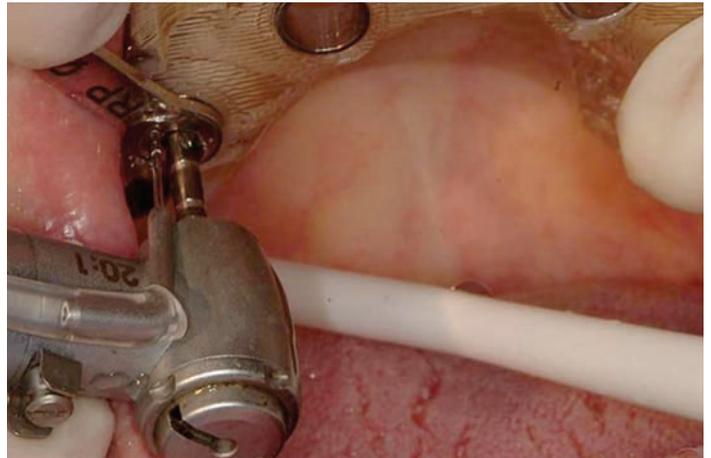
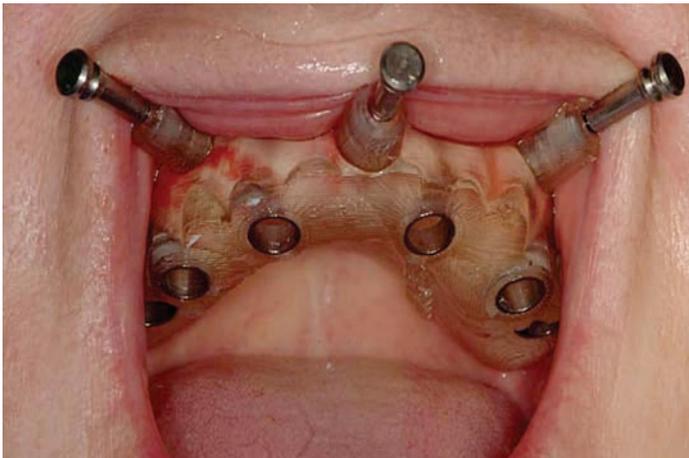
Guided implant surgery is a breakthrough technology which offers benefits previously unknown in implant dentistry.

1. It is a more precise and accurate procedure for placing implants.
2. Guided surgery preserves vital anatomic structures by allowing visualization of the relationship between the planned restoration and the bony anatomy. Traditional surgical guides are difficult to use predictably when there are no apparent anatomic references.
3. The technique may substantially reduce the time necessary for implant surgery.
4. Due to extensive planning prior to implant placement, there are fewer unexpected findings during surgery.

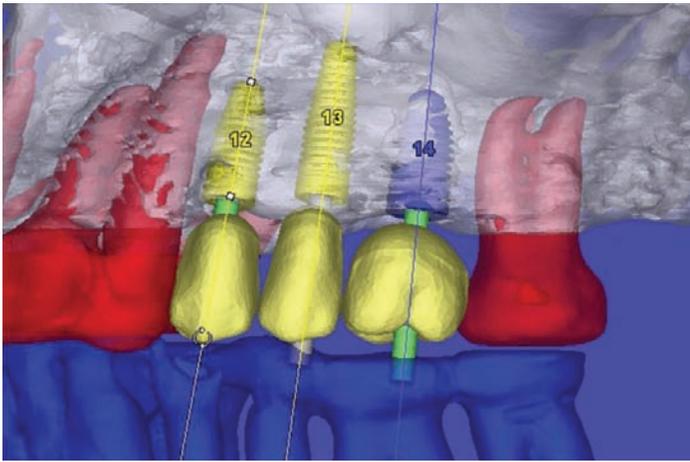
Drawbacks of Guided Implant Surgery

The primary drawbacks of guided surgery are:

1. Guided surgery requires the surgeon to invest in a specialized surgical kit and planning software.
2. Treatment planning may take longer than planning for traditional implant surgery.



Figures 2, 3 and 4. A fully edentulous guide is stabilized with horizontal pins in the patient's bone. Following guided drilling, the implants are placed through the guide holes.



Figures 5 and 6. Virtual software planning allows for construction of a precise surgical guide.



Figures 7 and 8. Placement of the guide allows for precise, pre-planned surgical positioning of implants.

Indications for Guided Implant Surgery

Because of its precision and accuracy, guided surgery may facilitate implant placement. Its many benefits far outweigh the possible objections of time, radiation exposure and cost.

Guided surgery is most beneficial in the following clinical situations.

- Planning for three or more implants.
- Proximity of the proposed implants to vital anatomy.
- Proximity of the implants to adjacent teeth.
- Questionable bone volume — bone deficient in width or height or with unusual bony contours.
- Flapless implant placement.
- Immediate restorations.
- Significant alteration of soft tissue.

Complications and Potential Errors of Guided Implant Surgery

Complications of guided implant surgery are the same as those for any implant surgical procedure.

Valent et al found the most common errors are mistaken acquisition of the tomographic image or incorrect processing, deviation of 0.1 to 0.2mm in the fabrication of the surgical guide, inaccurate fixation of the guide resulting in

displacement during the surgical procedure.

Protocol for Guided Implant Surgery

With traditional placement of implants, restorations are made after the placement of the implants from maxillary and mandibular arch impressions, a bite registration and diagnostic casts poured and mounted on an articulator.

In guided surgery, the first step is to plan the restoration. Guided surgery may permit the placement of a restoration concomitant with the insertion of the implants by developing the restorative plan in concert with the surgical plan. A digital or analog diagnostic tooth arrangement indicating the dental anatomy and positions of the teeth to be replaced is created.

A scanning prosthesis is placed in the patient's mouth and a CT/CBCT scan taken with the patient wearing the prosthesis. The scan is then imported into a dental software program which allows the clinician to "virtually" place the implants into their ideal positions in relation to the restoration and underlying anatomy.

The digital plan is then uploaded via the Internet for guide fabrication, permitting a laboratory to fabricate the surgical guide using CAD/CAM technology. The surgi-

cal guide is worn by the patient during surgery and used to place the implants in the same positions, depths and angulations as they were placed "virtually" in the planning software.

To perform guided surgery, the clinician needs:

Access to a Cone-Beam CT scanner. These CT scan machines are similar to those used to aid surgeons in joint replacement procedures but utilize much less radiation.

Implant Planning Software. Cone beam CT scanners produce images in a format called Digital Imaging and Communications in Medicine (DICOM). Implant planning software reads DICOM files and reconstructs them in 2-D and/or 3-D images. These software packages provide various tools for implant planning allowing the user to refer to the anatomic structure of the patient and plan a safe surgery. More than a dozen implant planning software programs are available, including Anatomage, NobelGuide/NobelClinician, Cybermed and SimPlant.

A Surgical Template. The surgical template is a laboratory-fabricated device which references the surgical planning information. Generally, it is the shape of an orthodontic splint and worn by the patient during surgery. Small sleeves are inserted into the surgical template to guide the drilling. Three types of computer-generated surgical guides are available:

tooth-supported guides, mucosa-supported guides and bone-supported guides.

Guided Implant Surgery Drill Kit. To use a surgical template for guided surgery, a special drill kit is necessary. This kit may include a tissue punch, drill sleeve and drills of various lengths and diameters which are compatible with the specific guides and implant manufacturers.

Conclusion

Guided surgery using 3-D implant patient evaluation and planning has opened new horizons for a multidisciplinary, restoratively- and surgically-driven treatment approach, the result of which is accurate and predictable placement of dental implants.

But the critical factors for success still remain proper diagnosis and case selection; the care, skill and judgment of the clinician; adherence to surgical and prosthetic principles; good communication between the implant surgeon and the restorative dentist, as well as patient awareness, education, and compliance.

Guided surgery is clearly one of the most important advances in implant dentistry. Because it is less invasive than conventional implant surgery, people on blood thinners and other medications may now enjoy the benefits of implant surgery they could not have in the past.

Understanding and adopting by careful analysis these groundbreaking technologies will not only change the way dental implants are placed, but will offer patients improved predictable outcomes.

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