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Surgical Guide for Implants and Dual Scan - A Review

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Abstract

In dentistry, an implant surgical guide is a tool used for accurate implant placement. To help dentists and oral surgeons plan the precise location, depth, and angle of implant placement, it offers a three-dimensional representation of the patient's oral anatomy. The guide improves predictability for the best possible functional and aesthetic results, encourages a minimally invasive approach, and reduces stress to surrounding tissues. Personalized for each patient, the surgical guide increases productivity, shortens the duration of the procedure, and helps ensure the long-term viability of dental implant restorations.

Keywords: Implants, Radiographic Stent, Surgical guides, Angulation, Implant planning

Introduction

Dental implants used in prosthodontic restorations require precise implant placement for dependable functional, hygienic, and cosmetic outcomes. Dental implant placement and angulation are facilitated by the use of a surgical guide. Stabilisation pins may or may not be used, and surgical guides may be made of bone, tooth, mucosa, or special support. [1,2]

"Prosthetically-driven placement" refers to the process of inserting an implant while taking into account the proper angulation, the location of the neighbouring teeth, and the underlying bone. When combined with 3D implant planning software, 3D imaging techniques like CT or cone beam computed tomography (CBCT) give routine preoperative radiographs an additional dimension, providing more detailed information on bone quality and quantity as well as anatomical limitations. This allows clinicians to view 3D information about the patient's anatomic structures along with information about the patient's final prosthesis.[3]

Computer-guided implant surgery protocols can be divided generally into;

1. Static protocols.
2. Dynamic protocols

Dynamic" protocols. Dynamic methods: also called navigation, it involves the use of a computer-guided navigation system that reproduces the virtual implant position directly from CT data and allows intra-operative changes of the implant position.

The "Static" methods employ a static surgical guide that reproduces the virtual implant position directly from CT data, it does not permit modification of the implant position during surgery.[9]

A stereolithographic guided surgery system mainly consists of; a stereolithographic surgical guide with implant system-related mounts for fixed installation, additional guide sleeves for fixation screw installation, drill keys of different heights, and depth-calibrated drills to prepare the osteotomies.[4]

Taking CT-guided technology to the next step involves the accurate fabrication of the restoration before implant insertion, with its immediate insertion at the time of surgery.[5]

The purpose of this article is to emphasise that an implant surgical guide is meant to improve the precision and predictability of the implant placement procedure. The surgical guide is a useful tool for oral surgeons and dentists because it enables careful planning and accurate execution of dental implant treatments. Better results, more patient happiness, and enhanced long-term success of dental implant restorations are the ultimate results of this.

- **Radiographic stents and surgical stents**

The demand for a predictable prosthesis ultimately led to the development of prosthetically guided implantology. This idea states that the precise location of the implant is determined at the diagnostic stage in accordance with the final restoration that has been planned. The ideal position and angulation of the implant should be established during implant placement surgery, taking into account the shape of the bone and the existence of any critical structures around the intended implant site for the eventual prosthesis. Using surgical stents during surgery and a radiographic stent during implant treatment planning are two ways to accomplish an exact implant location.

The use of a radiographic template with CBCT for planning implant position and a surgical stent during the surgery can play an important role. The use of surgical stents during surgery can help to prevent implant placement in undesirable sites, reduce unrequired osteotomy, result in appropriate prosthesis design, reduce the required surgical time and trauma, and increase patient comfort. [6]

The ideal features of a radiographic stent

- Radiopaque indicator of correct tooth form and position without inducing scatter
- Retentive and stable intraorally
- Comfortable
- Sterilizable, if used as a surgical guide
- Compatible with scanner (hardware) platform

Radiographic stents for implant placement

- **Surgical templates**

Surgical templates have a very essential role in implant placement.

They help in positing of implant in an accurate location with the desired angulation.

The fabrication of the surgical guide templates is then based on one of the following design concepts.[7,8]

- Nonlimiting design
- Partially limiting design
- Completely limiting design

Non Limiting Design: Nonlimiting designs only indicate to the surgeon where the proposed prosthesis is about the selected implant site. This design indicated the ideal location of the implants without any emphasis on the angulation of the drill, thus allowing too much flexibility in the final positioning of the implant.

Partially Limiting Design: In such a design, the first drill used for the osteotomy is directed using the surgical guide, and the remainder of the osteotomy and implant placement is then finished freehand by the surgeon.

Completely Limiting Design: Completely limiting design restricts all of the instruments used for the osteotomy in a buccolingual and mesiodistal plane. Moreover, the addition of drill stops limits the depth of the preparation, and thus, the positioning of the prosthetic table of the implant.

This includes 3 popular designs:

1. cast-based guided surgical guide
2. computer-assisted design and manufacturing (CAD/CAM) based surgical guide
3. Stereolithography [7,8]

- **Cast based guided surgical guide**

The surgical guide is a combination of an analog technique done along with bone sounding and the use of periapical radiographs in a conventional flapless guided implant surgery.

The periapical radiograph is modified using digital software to help in the transposition of root structure onto the cast. The cast is then sectioned at the proposed implant site, and bone-sounding measurements are transferred to help in the orientation of the drill bit to perform a cast osteotomy. A laboratory analog is placed in the site, and a guide sleeve consistent with the implant width is modified to create a framework and the teeth.

- **Computer-assisted design and manufacturing (CAD/CAM) based surgical guide**

The dentist and surgeon can see a patient's anatomy in three dimensions thanks to CT/CBCT scanners. The precise location of the maxillary sinuses, soft tissue thicknesses, the proximity and root anatomy of neighboring teeth, the height and width of the available bone for implant placement, and other important and relevant structures like the mandibular canal, mental foramen, and incisive canal can all be seen. After photos have been loaded into a proprietary software application (like Simplant or Nobel Clinician), the clinician can then virtually treatment plan the placement of implants for an individual patient’s anatomy and case plan.

Computer-generated surgical drilling guides can then be fabricated from the virtual treatment plan. These surgical guides are used by the doctors to place the planned implants in the patient's mouth in the same positions as in the virtual treatment plant, allowing more accurate and predictable implant placement and reducing patient morbidity.

- **Stereolithography**

This technique uses advanced computer software (Surgi Case, Leuven, Belgium) along with a rapid prototyping

technology called stereolithography to achieve this. It permits graphic and complex 3D implant stimulation and fabrication of computer-generated surgical templates that sit directly on the bone and are preprogrammed with the individual depth, angulation, mesiodistal, and buccolingual positioning of the individual implants as planned during the 3D computer workup.

- **Guided implant surgery**

In guided implant surgery, a computer software plans the procedure using the patient's CT scans. The constraints of traditional implant planning using panoramic X-ray pictures include the difficulty of precisely executing the surgery plan. Nonetheless, guided implant surgery can be carried out precisely and accurately as intended. A sophisticated surgery toolkit and a tailored surgical template are required for guided implant surgery.

Guided implant surgery requires the following tools

- Medical or Cone-beam CT
- Implant planning software
- Guided implant surgery drill kit
- Custom surgical template
- Guided implant surgery follows the following procedures

Indications

- For placing three or more implants in a row
- When implant placement is in proximity to adjacent teeth, anatomic structures
- Inadequate bone volume
- Flapless surgery is desired
- Immediate loading of implants

Advantages

- Simple, easy and cost effective
- More precise placement
- Increased predictivity and safety
- Less time consuming

Limitations

- Expensive CT equipment is needed.
- Patient's bone cannot be checked during flapless surgery.
- Long learning curve.
- Difficult to deal with unexpected situations during surgery.
- Requires purchase of Surgical Kit and Surgical Template

Dual Scan Technique

The double scan protocol is a reliable and well-known process to obtain a fusion between the anatomical data (CBCT) and the prosthetic data (radiographic template).

Patient pervious denture is verified for fit, if the fit is found unsatisfactory an impression is made with PVS

Dry denture and place 5 markers on the buccal flange on different planes as shown in the below images and 3 markers on the lingual or palatal for a total of 8 markers

2 CBCT scans will be conducted

Scan 1: CBCT of the patient with the denture in the mouth biting into the occlusion so it is seated properly.

Scan 2: CBCT of the denture only with the markers and the wash still in place.

Markers for dual scan

Scan 1 in occlusion

PROS

- No surface scan is needed.
- Established and documented.
- Reproducible.
- Prosthetic driven.
- Guide based on appliance.

CONS

- Accuracy of CT scans.
- Refit of denture/appliance.
- Time-consuming manual work.
- CT scanner configuration inaccuracies are carried through.

Conclusion

Conventional or free hand implant placement has been done for many years, but with advent of new technologies and advancement in imaging field. More precise implant placement has become possible. As days pass by implant has become a upmost for replacement of missing teeth by using t Surgical guides, radiographic guides precise and accurate implant placement has become possible.

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