SURGICAL GUIDES- A BOON FOR IMPLANT PLACEMENT MANOEUVRE

Pratik Prakash Bumb[1], A. P. Nirmal Raj[2], Madhurima Sharma[3], Arkaprava Saha[4], Tambolkar Rajeshwari A[5], Ratan Upadhyay[6]
Post graduate[1,4,5,6], Professor and Head[2], Professor[3]
1-6- Department of Prosthodontics and crown and Bridge, Teerthanker Mahaveer Dental college and Research Centre, Moradabad Uttar Pradesh, India

Abstract
Over recent years, arrival of osseointegration has caused increased utility of implants. Implant prosthesis that are planned prosthetically assures acceptable esthetics, function and maintenance of hygiene which ensures a long-term success of implants. Accurate treatment planning and execution of planned treatment is therefore necessary for successful treatment. Implant complications are usually the untold consequences of incorrect diagnosis, inadequate planning, method of surgery, technique and also the placement. These problems can be conveniently solved and avoided by using surgical guides for placement of implants. Surgical templates have allowed clinicians to deliver a predictable rehabilitation outcome. Use of guides have not only lowered the chances of iatrogenic damage to anatomic structures; but have also increased the aesthetic, functional benefits of prosthodontically driven implant placement and the prosthesis in long run.Success in the proposed treatment can be achieved and executed by combining the uses of CT, 3D implant planning software, production techniques for templates using image guidance, and computer-aided surgery as and when needed. This article aims at describing the various systems of making surgical guide and advances in using surgical guide in various clinical conditions. Also, an overview of the advantages and limitations for the same.
Key Words:

INTRODUCTION:

As rightly said, if the clinician is assumed as 'a pilot', then surgical guide is considered his 'navigator'. Surgical guide is the connecting link between what is in thought (planned treatment) and what is going to be executed (outcome). Determining the osteotomy path prior, helps the surgical procedure significantly.[1] GPT-8 defines surgical template as a guide used to assist in proper surgical placement and angulation of dental implants.[2] Since the dental implants grew popular as treatment modality for replacing teeth, the assessment of patient anatomy and in turn the association between clinicians and surgeons have become vital factors for successful outcomes.[3] Conventional IOPa's , OPG's radiography along with visual inspection and clinical palpation may not suffice the need to get the appropriate pre surgical planning in compromised or complex patients.[4] At last, the main aim of placing an implant is to position it within the bone adequately such that it offers the best possible function without any complications or any aesthetic compromise. Hence, the overall implant treatment process has to be prosthetically driven.[5] Hence, use of the surgical guide is not limited only to placing implants in critical conditions considering the anatomy but also for routinely placing implants in ideal position, thereby increasing the aesthetic and benefits in function of prosthodontically driven placement of implants. Also, manual errors of placement can be prevented.[1,6]

USES OF SURGICAL GUIDE

- Guides osteotomy drills at required position, depth, angulation.
- Guides implant fixtures at required position, depth and angulation.
- Guides the of amount of bone to be reduced or harvested if needed. (both soft and hard tissue)[1,6]

Classification of Surgical templates:[1]

1. Based on operated area
1.a Guide for partially edentulous sites (tooth or bone supported; determined by the span of edentulous space)
1.b Guide for completely edentulous sites (supported by mucosa or bone).
2.Based on guide support:
Rules for planning usage of different types of surgical guides are as follows[7]:

2.a Tooth supported guide - Minimum 3 teeth stable support should be present.

2.b Mucosa supported guide - It is used in completely edentulous sites. The main benefit of these guides is that very minimum reflection is needed, so reduces postoperative uneasiness.

2.c Bone supported guide - They are used in partially & completely edentulous patients. When utilized in partially edentulous sites, the guide should have a minimum of 3 cm of supporting bone or 3 teeth that needs to be replaced. Bone supported guides are utilized specifically when edentulous sites have relatively less bone thickness. Flap should provide a clear view to surgical site and guides should be inserted easily.

3. Base on utility
3.1 Pilot guides - Only allows pilot drills. Angulation is controlled. Depth control is achieved manually with the help of markings on drills. Further, the template is taken out, site is expanded without presence of the guide.

3.2 Complete drill guides - It uses drill keys or sleeves. Various sleeve for varied diameters of drills, that are replaced consecutively as osteotomy is enlarged Guide controls angulation and osteotomy size but depth is manually controlled.

3.3 Safe guides/easy guides - Uses drill key or sleeves with an implant stopper as to control drilling dept. This allows osteotomy with surgical drills and also implant placements.[7,8]

4. Based on material:
Self-cure/ light cured acrylic resins, templates incorporated with metal; vacuum formed polymers, milled, prosthesis using CAD CAM and stereolithographic models. The accuracy of vacuum formed guides and manually processed resin is lower than that of milled, CAD-CAM prosthesis or stereolithographic model.
Guides for implant placement can be broadly categorized into:[9]
1. Customized Conventional Radiographic Surgical Templates
2. 3dimensional computed tomography imaging.
3. Implant-planning software based on CBCT.
4. Computer-aided-design/computer- aided-manufacturing (CAD/CAM) technology
a. Computer guided implant surgery (CGIS)
b. Computer navigated implant surgery (CNIS)

1.Customized Conventional Radiographic Template:[8]
Conventional panoramic radiographs are generally executed by making patient wear the radiographic template that are incorporated with metal spheres/ rods, sleeves, guide posts at wax up level.
Depending upon the known magnification and dimensions of metal, planning for the dimensions and depth of the fixtures are done.

- Fabrication of the guide:
  a) Diagnostic casts mounted at centric relation position.
  b) It is then restored at vertical dimension of occlusion.
  c) This wax-upcast is duplicated.
  d) Template is fabricated on duplicated cast.
  e) Stent is fabricated as polymerization has been completed.
  f) Access holes are made & metallic sleeves or Gutta-percha placed in desired implant location.
  g) Radiographs or CT scan is done with the surgical guide in place

- LIMITATIONS OF CONVENTIONAL RADIOGRAPHIC SURGICAL TEMPLATE:[1]

1. Panoramic radiography has some diagnostic shortcomings, like:
- Magnification as well as distortion,
- Artifacts related to different positions.
- Bucco-lingual bone width is not determined.

2. Soft tissue resiliency , underlying bone topography remain undetermined as the guide is fabricated on a rigid cast.
3. Anatomical landmarks are not precisely located and approach is always two dimensional.

2. Three-dimensional computed tomography (CT) imaging:[8]
3D imaging has become an important diagnostic tool, for overcoming the limitations of two-dimensional imaging techniques
It enables 3D viewing of the area of interest and corresponding important limiting structures like maxillary sinus and mandibular nerve.
It is also used for estimating alveolar bone density.
CT imaging gives uniform magnification of the scanned area, multiplanar views, and simultaneously studying multiple number of implants for better planning.

- LIMITATIONS OF 3D COMPUTED TOMOGRAPHY IMAGING:
  a) Scattering or artifacts like beam hardening because of metal structures in the vicinity
  b) Relatively higher costs for CT examination.
  c) Higher radiation dose and exposure to the patient.

3.CBCT-based implant-planning software:
Considering shortcomings of CT imaging, CBCT will play an important and practically better option in the presurgical radiographic evaluation of potentially valid future fixture positions.
Numerous factors associated which influence the possibility of restoration of implant, that are assessed in tomographic scanning. While planning implants, perfect trajectory towards contralateral teeth and resulting occlusion should be studied. Evaluation isn't possible every time because the other arch may not be included in the FOV. Hence, having knowledge of the restrictions of stock and custom abutment designs is important.[5]
Though feasible for restoring, excessive implant to crown angulations, may cause unfavourable distribution of

forces which may lead to failure of implants. A proper evaluation of the available space between the arches therefore will help aid in determining if enough height is available for restoration of implants .[10]

Procedure:

- Scanning of the patient is done using radiographic markers (artificial) which are placed in stents or jaws, or with natural markers like teeth or bony landmark and thereafter digital images are formed.
- The scanned data is then imported in an implant-planning software program. The data is converted into a digital 3D model of area to be treated, providing a clear visual of the bony anatomy of the patient.
- This permits visualizing and executing of the digital surgery in ideal position and in an appropriate manner which is prosthetically driven.

4.Computer-Aided-Design/Computer-Aided-Manufacturing Technology (CAD-CAM**)**

The transferring of the digital planning of the treatment into actual patient treatment has become a reality because of the revolution brought by CAD/CAM technology, that is used in 2 guided surgery systems i.e ,

(1) "Static" or "template-based system
(2) Dynamic system or "surgical navigation/computer aided navigation technology

CAD/CAM utilises data from CT scan for treatment planning. The CT images are converted into data which are identified by a CT imaging and planning software. This software then transfers the presurgical plan to the surgical area with the help of stereolithographic drill guides.[11,12]

4.a. Computer Guided Implant Surgery (Static System)[5,11]

CGIS is the system which communicates the pre decided sites using surgical templates in the surgical area and are manufactured by using rapid prototyping techniques like 3D printing and stereolithography.

The static system uses a surgical guide for reproducing the virtual implant position at surgical site. For overcoming the limitations of conventional radiographic surgical template, use of computer manufactured surgical template has come into picture. This surgical guide is fabricated using stereolithography process.

#Procedures in fabrication of stereolithographic templates[11,12]

1. Fabrication of Radiographic template.
2. CT scan procedure
3. 3D computer simulation/Using software for implant planning.
4. Fabrication of template/guides.

4.b. Computer navigated implant surgery (CNIS)[9-12]

The CNIS system dictates virtual planned treatment to the field of operation using visual imaging tools on a computer monitor, instead of the intraoral guides. It utilizes a surgical navigation system that reproduces virtual implant position directly using optical bur tracking system and doesn't require an intraoral surgical guide**.**

CNIS is the surgical placement of implants using a real time computer guided system based on information generated from CT image. This system is powered by a motion tracking technology, that detects positions of the dental drill & patient throughout the implant placing procedure.[5,11]

Advantages of Computer navigated implant surgery:

1. Intraoperative changes in implant position can be made when needed accordingly.
2. Continuous visualization of drills on computer screen in all the 3 dimensions i.e X, Y, Z axis because of bur tracking system
3. Shortcomings of CGIS like thermal injury, displacement or fracture of guide etc. are also avoided by CNIS

Elian., et al. did a study to find out the accuracy of implant placement using CNIS and found that mean linear accuracy at implant neck and apical tip was less than 1mm. His study also concluded that mean angular deviation for the implant that were placed using CNIS system was less than 4°. On the contrary, for the implants placed with stereolithographic guide had the mean linear accuracy in range of 1.1-1.45 mm at the implant neck and at the implant apical tipi it was 1.41-2.99 mm. Also, mean angular deviation ranged between 2° to 7.25°.[9,13]

CONCLUSION:

A position equal to the maximum permissible deviation of the implant placement is important for a successful treatment outcome. Surgical guides help the clinician to plan and establish excellent implant prosthetics which provides desirable esthetics, function, and hygiene maintenance.

REFRENCES:

1.T Umapathy, Chirenjeevi Jayam, BS Anila, CP Ashwini. Overview of surgical guides for implant therapy. Journal of Dental Implants Jan - Jun 2015; 48-52.
2. The glossary of prosthodontic terms. J Prosthetic Dentistry 2005; 94:10-92
3. Ganz SD. Computer-aided design/computer-aided manufacturing application using CT and cone beam CT scanning technology. Dent Clin North Am 2008; 52(4):777–808, vii.

4. D'Haese J, Van De Velde T, Elaut L, et al. A prospective study on the accuracy of
mucosally supported stereolithographic surgical guides in fully edentulous maxillae. Clin Implant Dent Relat Res 2012;14(2):293–303.
5. Maria A. Mora, Douglas L. Chenin, Roger M. Arce. Software Tools and Surgical Guides in Dental-Implant-Guided Surgery. Dent Clin N Am 58 (2014) 597–626.
6. Ramasamy M, Giri, Raja R, Subramonian, Karthik, Narendrakumar R. Implant surgical guides: From the past to the present. J Pharm Bioallied Sci 2013;5:S98-102.
7. Drill guides for every case scenario:Surgi Guide Cookbook. Available from: http://www.materialisedental.com/materialise/view/en/2395185.SurgiGuide+dental+drill+guide+Cookbook.html.
8.Pesun IJ, Gardner FM. Fabrication of a guide for evaluation and surgical placement of implants. J Prosthet Dent 1995; 73:548-52.
9. Varun Menon P. "Navigation in Implant Dentistry". EC Dental Science 14.3 (2017): 167-171.
10. Tagger Green N, Machtei EE, Horwitz J, et al. Fracture of dental implants: literature
review and report of a case. Implant Dent 2002;11(2):137–43.
11. D'Souza KM, Aras MA. Types of implant surgical guides in dentistry: A review. J Oral Implantology 2012; 38:643-52.
12. Kola, et al.: Surgical templates for dental implant. Nigerian journal of surgery Jan-June 2015; vol21(1) 1-5.
13. Casap N, Wexler A, Persky N, Schneider A, Lustmann J. navigation surgery for dental implants: Assesment of accuracy of the image guided implantology system. J Oral Maxillofac Surg. 2004:62(9 Suppl 2):116-119 .

Corresponding author
Pratik Prakash Bumb
Post Graduate
Department of Prosthodontic
TMDC&RC, Moradabad

How to cite this article: Bumb P, Raj N, Sharma M, Saha A, Rajeshwari ,Upadhyay R.surgical guides- a boon for implant placement manoeuvre. TMU J Dent 2021;8(3)13-16.