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Prosthetically Guided Implantology - The Great Growling Engine of Change: A Review

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ABSTRACT

Good aesthetics, function and more importantly hygiene maintenance enabling long time success are the qualities of a prosthetically driven implant prosthesis. The accuracy of treatment planning and its implementation are vital for its success. The radiological templates and surgical guides based on Cone-beam computed tomography (CBCT) and computer-aideddesign/computer-aided manufacturing (CAD/CAM) are of immense help in clinical translation of the preoperative implant planning. The surgical templates provide a predictable surgical & prosthetic rehabilitation. Surgical guides have reduced the chances of iatrogenic damage of critical anatomic structures and improved the aesthetic and functional advantages of prosthodontic-driven implant. Glossary of prosthodontic term 8 defines the surgical template as a guide used to assist in proper surgical placement and angulation of dental implants. Surgical guide is the connecting link between what's in mind and what will be executed. Predetermining the suitable osteotomy path for the clinician significantly helps the surgical procedure.

KEYWORDS:Surgical guide, CAD/CAM (computeraided design/computer aided manufacturing), Stereolithography(SLA)

I. INTRODUCTION

Precise planning and special care during surgery are required for rehabilitating a patient with an implant. Real problem - placing a poorly planned implant, such as the perforation of critical anatomical structures, increased surgical duration, patient anxiety, painand stress. Therefore, presurgical planning using instruments such as tomography and surgical guides is essential.[1,2,3]Surgical guides are templates transferring information regarding tooth position to the dentist prior to implant placement. Earlier dental implant position and placement mainly depends on residual bone availability only.[4] Because of this after placement of implant planning of prosthesis is very difficult. These difficulties lead to entry of prosthetic driven implantology. This prosthetic driven implantology includes surgical guides or surgical templates. As there is relatively restricted space in oral cavity, ahigh degree of accuracy in placement of an implant is very important for success of the prostheses. It is achieved by means of a surgical guide which provides adequate information regarding implant placement and at the time of surgery which fits on to the existing dentition or on to the edentulous span.[5] Hence, rising demand for dental implants has resulted in the development of newer and advanced methods for the fabrication of these templates.Since, the conventional surgical guides are made of acrylic resin that, does not provide the crucial anatomical knowledge required for the surgical procedure. For carefully positioning the implants and avoiding the bone augmentation procedures, and optimizing the surgical procedure, cone-beam computed tomography (CBCT) - guided implant surgery has been the right option because implants inserted using virtually guided procedures are more precise than those involving conventional procedures.[6-8]

USES OF SURGICAL GUIDE:

•Guidance of osteotomy drills at correct position, angulation anddepth.

•Guidance of implant fixtures at correct position, angulation anddepth.

• Guidance of amount of bone reduction or bone harvesting if necessary (both soft tissue and hard tissueharvesting).[9]

CLASSIFICATION OF SURGICAL GUIDES:[10]

1) Based on the area of operation:

• Partially edentulous sites - guide (tooth supported or bonesupported).

• Completely edentulous sites - guide (mucosa or bonesupported)

2) Based on the support the surgical guide derives:

•Tooth supported guides - Minimum of three stable teeth must be present for supporting the guide during surgery(Fig.1).

•Mucosa supported guides – for the fully edentuloussites.

Advantage – As less or no tissue reflection is required, thus less postoperative discomfort, and requires scan prosthesis and surgical guides during surgery (Fig.2).

•Bone supported guides - used in both the partially and completely edentulous sites. Bone guideshould

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possess at least 3cm of supporting bone or 3 teeth would need replacement, if used in partially edentulous sites.These guides are used when edentulous sites possess thin bone. The implant sites and insertion of guides are provided a good view with a raised flap.(Fig.3)

Fig.1:Toothsupportedguide

Fig.2: Mucosa supportedguide

Fig.3: Bone supported guide

3) Based on the accessibility the surgical guides can be open sleeve or closed sleeve (increased accessibility)(Fig.4 andFig.5).

Fig.4:Opensleeve

Fig.5: Closedsleeve

4) Based onutility:

•Pilot guides / Non-limiting - The sleeves only allow pilot drills, thus angulation control is achieved. Depth control is obtained manually by assessing the drill-markings. Then, the surgical guide is removed, and osteotomy site is expanded in the absence of surgical guide(Fig.6).

• Complete drill guides / Partially limiting - It uses drill keys or sleeves. With the widening of the osteotomy,thedrillswithdifferentdiametersare changed concomitantly for different sleeves. Angulation as well as the size of osteotomy is controlled through the guide, while the depth is control is gained manually(Fig.7).

• Safe guides/easy guides / Completely limiting - Uses drill key or sleeves with additional implant stopper which controls the depth of drilling. Allows both osteotomy preparations with surgical drills and the implantinstallation(Fig.8).

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Fig.6:Pilot guide

Fig.7: Complete drill guide

Fig.8: Safe guide/easy guide

5) Based onmaterial:
Light cure acrylic resin, metal re-inforced acrylic templates; vacuum formed polymers, milling, CAD CAM prosthesis, stereo lithographic models. The manually processed resins and vacuum formed guides have lesser surgical efficacy when compared with the milling, CAD-CAM prosthesis or stereo lithographic models.

CLASSIFICATION OF DESIGN CONCEPTS FOR FABRICATION OF SURGICAL GUIDE

1) Non Limiting Design[11,12,26]

Blustein et al and Engelman et al, suggested a technique wherea guide pin hole was drilled through a clear vacuum-formed matrix. The optimal position of the dental implant is indicated by this guide pin hole. However, the angulation was determined by the using an adjacent and opposingteeth.

2) Partially LimitingDesign[13,14,27]

In such designs, the first drill used for the osteotomy is given direction by using the surgical guide, while the remaining osteotomy and implant placement is finished in freehand by the operating surgeon. In this techniquea radiographic template is fabricated, and is subsequently converted into a surgical guide template following radiographic evaluation. This technique has failed to completely restrict the angulations of the surgicaldrill.

3) Completely LimitingDesign[15,19,28]

This design restricts all the instruments used in surgical procedure during implant placement. Drill stops limits the depth of the preparation. As the surgical guides becoming more restrictive, lesser decision making and subsequent surgical execution is done intra-operatively. The virtual three-dimensional (3D) views of the bony morphology provides the surgeon with a good view of the surgical bone site prior to implant placement. This technique helps in promoting flapless surgeries, allows presurgical construction of the master cast and provisional restorations, and facilitates the immediate loading. Special training for familiarity with the entire system and special equipment is needed.

This includes two popular designs:

- Cast-based guided surgicalguide

It is an analogue technique to combine bone sounding and the periapical radiographs in a conventional flapless guided implant surgery. The periapical radiograph is modified through the digital software, thus helping in transposition of root structure onto the cast. The cast is thus sectioned at the proposed implant site, and bone-sounding measurements are shifted, so that the drill bit is oriented for performing a cast osteotomy. A laboratory analogue is placed in the site, and a guide sleeve consistent with the implant width is modified using wires that are used to create a framework around the teeth. Vinylpoly-siloxane

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occlusal registration material is used to form the superastructure.[15,17,29]

- Computer-assisted design and manufacturing (CAD/CAM) based surgicalguide.

The fabrication-procedure of CAD/CAM based surgical guides can be divided into the following steps:

- Fabrication of the radiographictemplate,
- The computerized tomographyscan,
- Implant planning via interactive implant surgical planningsoftware,
- Fabrication of the stereolithographic drillguide[17]

FIXING AND SUPPORT

•Fixing the template with screws:

For this type of template fixation, the dedicated screws with diameters 1.3, 1.5mm or 1.8mm are used. It is usually necessary to make pilot holes in the bone. The drilling axis and depth should be planned and determined by the sleeves that are guides for the drill (Fig.9) .[18,20]

•Fixing the template with the pins :

As with the use of screws, the drilling of pilot holes is needed. The drilling axis and depth should be planned in the implant planning software and depends on the length and diameter of the pins. The pins for stabilization of templates with dedicated sleeves are offered by Straumann, Neodent and Nobel Biocare. Using the pins for fixing makes removal and reinstallation of the guide easier during the procedure without the risk of resizing of the holes in the bone with a threaded screw. However, it is essential to correctly plan the position for the pin within the existing cortical bone (Fig.10).16,18

•Stabilization of the template with additional titaniumpins:

This type of template stabilization is performed using dedicated titanium thick pins. They are inserted in the axis of the osteotomy for the future implant, and in the situation when more implants will be placed. The diameter of such an instrument matches the diameter of the sleeve in the template and the diameter of the hole made in the bone. Usually, they are color-coded (Fig.11).[18,21]

Fig.9: Template with the screwFig.10: Template with the pins

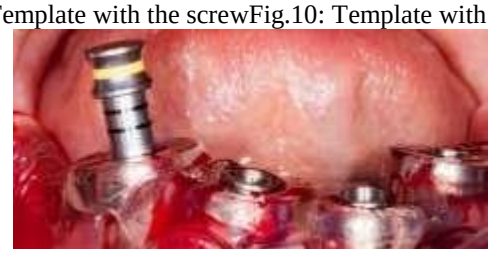

Fig.11: Template with additional titanium pin

IMPLANT SURGICAL GUIDE KIT

Surgical guide kit contains drill handle, guide tubes, c handle, template fixation pins, retentive anchor driver, stop key for guided implants, mucosal punch, T- sleeve.

SELECTION OF RETENTIVE ANCHOR PINS

Mainly depends on type of the surgical guide, implant number, position of edentulous site, presence of any anatomical limitations (maxillary sinus, mandibular nerve), and length of fixation screws. Ideally the fixation screws should be positioned vertically because vertical position stabilizes the guide the most and also the have the added advantage of easier accessibility for placement.[10]

DISINFECTION OF SURGICAL TEMPLATES[22-25]

Disinfection of surgical guide is done by

1.Chlorhexidine gluconate

2.Plasma sterilization with hydrogen peroxide (the sterilization cycle takes 45- 105 minutes run at 40 degreeCelsius)

3. Pure ethylene oxide or its mixture with carbon dioxide(1:9)

4. Sterilization of surgical templates inautoclave

5. Submerging the surgical guides in 70% alcohol for a minimum of 15minutes

II. CONCLUSION

Dental implants are the better treatment of choice in recent days for replacement of missing teeth. For success of dental implants proper execution of treatment plan is important. Various studies have shown that dental implant placement with the help of surgical guides is a successful criteria than conventional dental implant placement. Surgical guides being a valuable adjunct in achieving precision in prosthetic driven implantology, enables the clinician in orienting the implant three-dimensionally. The guides serve diagnostic as well as surgical purpose and depending on the case it may be manually constructed or CAD/CAM ones.Surgical guides also enable the clinician in establishing good implant prosthetics, predictable positioning allows for the better prosthetic outcome by simplifying abutment selection providing excellent aesthetic, function, and hygiene maintenance. But compared to the conventional technique, surgical guide requires substantially greater investment and effort. The choice of guide in terms of design and method of fabrication depends on the case and expertise of the clinician.One must have a thorough knowledge about the design consideration, laboratory procedure, advantages and disadvantages of particular surgical guide to choose the best one for the benefit of thepatient.

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