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Free Hand Vs Guided Implant Surgery

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Abstract:- Even though implant success depends primarily on osseointegration, prosthesis plays a crucial role in determining the longevity of the implant. Additionally, esthetics should also be served to please the patient. To fulfill these objectives effectively, prosthetically driven implant placement technique is recommended. This article aims to explore various implant placement techniques, delving into their respective advantages and disadvantages.

I. INTRODUCTION

In the field of dentistry, while there exist alternative methods for replacing missing teeth, dental implants offer distinct advantages compared to other options. That is, implants closely mimic natural teeth, preserving adjacent teeth and preventing underlying bone loss.

The placement of dental implants can be carried out through two primary methods: freehand or with the assistance of a surgical guide. It is crucial to carefully select the most suitable implant placement technique for each individual case to minimize the risk of potential complications.

II. FREE HAND VS GUIDED IMPLANT PLACEMENT

Replacement of teeth with implants is done majorly to preserve the underlying bone and to provide good functional efficiency. If the implant is replacing an anterior tooth esthetics become the primary concern. Hence, whatever the requirement may be, it is crucial to choose the ideal implant size and its optimal position which is accurately possible with 3D radiographic interpretation. Through CBCT not only important landmarks, ideal implant position is identified, but also the DICOM data can be used to create a surgical guide.

Implant placement can be done either by free hand placement or using a surgical guide. Free hand placement and guided surgery have their own advantages and disadvantages. Hence, the technique that must be used varies from case to case.

A. Free hand implant placement

Free hand implant placement allows the clinician to assess the bone directly and to graft the site after elevating the flap. Selection of the implant size prior to surgery is possible when CBCT is used as radiographic assessment but if there's only 2D radiograph, caliper can be used to determine the bone diameter and length after flap elevation in direct vision. The adjacent tooth is taken as reference to decide the position of the implant. The distance between the implant and tooth is supposed to be 1.5 mm and distance between the two adjacent implants should be 3 mm at least. Below are listed the advantages and disadvantages of this technique.

➢ *Advantages*

- Bone augmentation can be done if required.
- Economically less than guided surgery.
- Good irrigation is possible.
- Can be done in patients with less mouth opening.

➢ *Disadvantages*

- Excessive bleeding.
- Increased healing time due to complete flap elevation.
- Traumatic experience to the patient due to increased duration of the treatment.
- Swelling and pain.
- Difficult to place implants in desired position in full mouth rehabilitation.
- Possibility to place implants close to adjacent tooth or tooth root due to improper planning consequently leading to bone loss or periimplantitis.
- Implant placement based on thickness of the bone sometimes leads to incorrect positioning of the implant or in non-esthetic zones.

Hence, free hand implant placement is best indicated for single tooth replacements and economically poor patients.

III. DIGITAL IMPLANT PLACEMENT

The significance of surgical guides in implantology becomes particularly evident in cases of full mouth rehabilitation, where there is a deficiency in both bone and tissue, making it challenging to control the drilling process. Additionally, the absence of natural teeth possesses a challenge in determining the spatial position for implant placement. In such scenarios, surgical guides serve a crucial role by either guiding the clinician to the precise target site or exerting complete control over the movement, speed, and depth of the drills.

Before the surgery, measurement of available bone at the intended implant site and the identification of critical anatomical landmarks, such as the Inferior Alveolar Nerve (IAN), using CBCT scans can be done.

Furthermore, the size and diameter of the implant to be placed can be carefully determined as well. Subsequently, merging of the DICOM data of the CBCT and intraoral scans in the implant planning software makes it possible to plan the surgery according to the knowledge and visualization of the clinician.

The desired position of both the prosthesis and the implant can be visualized and simulated using implant planning software. Nevertheless, prosthesis path of insertion, screw channel and abutment type and size can also be determined and altered. The complete data is then transferred

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onto the surgical guide.

The sleeve of the surgical guide encapsulates vital information about the diameter, direction, and depth at which the implant should be positioned. This approach facilitates implant placement that is driven by prosthetic considerations and minimizes deviations apically and coronally, ultimately leading to more precise and successful outcomes.

Guided implant surgery is recommended in patients with satisfactory bone quantity for implant insertion as well as for complete edentulous arches in the maxilla or mandible. Additionally, guided surgery is the preferred treatment option for patients with specific constraints, such as those undergoing mandible reconstruction using free flaps following oncological resection.

Surgical guides can be classified into 3 types based on the guidance they provide to the practitioner.

- Nonlimiting
- Partially limiting
- Completely limiting

A. Nonlimitng Guides

This technique only replaces the edentulous area with prosthesis. Therefore, guiding the clinician to determine the implant position and where the initial drill is supposed to be drilled. It does not control the drilling length and direction. Thus, allowing too much flexibility and increased chances of human error.

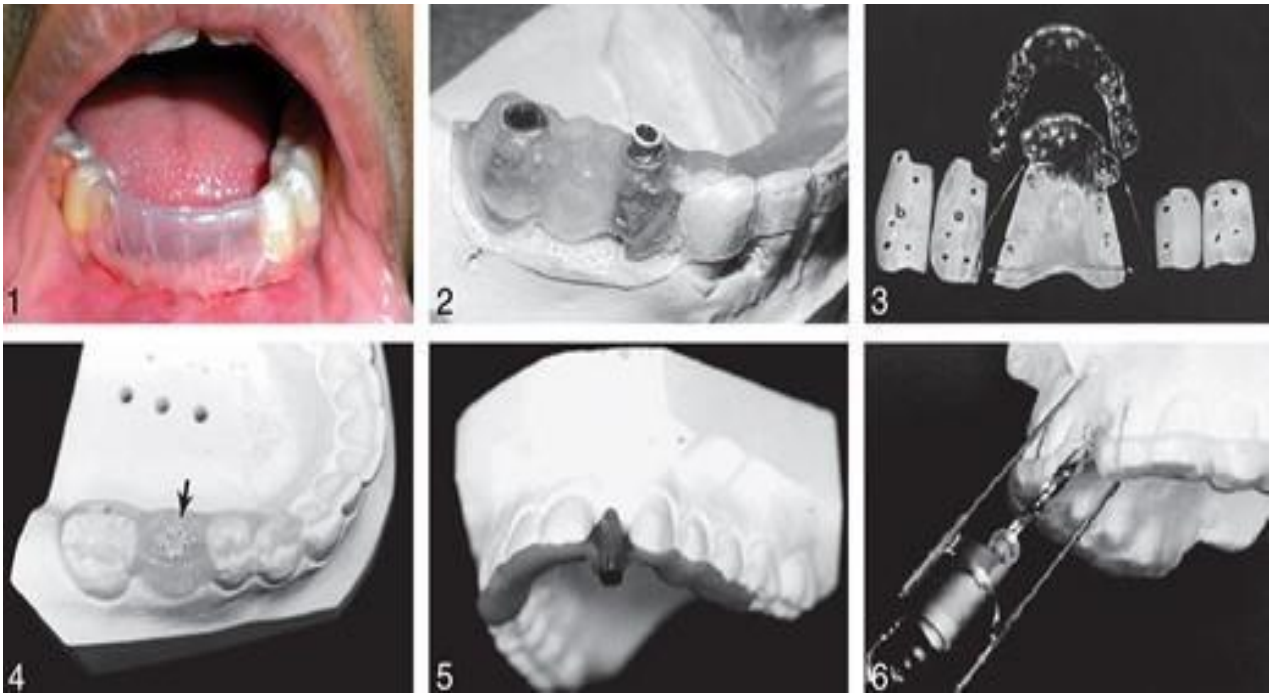

Figure 1 - Locating implant initial drill position using nonlimiting guide

B. Partially Limiting Guides

This technique uses a pilot drill guide where the initial drill is controlled and directed by the surgical guide into the osteotomy site providing an accurate entry point and rest of the drilling protocol is done using free hand technique.

C. Complete Limiting Guides

This technique limits all the 3D movements of the drills. Mesio-distal, bucco-lingual and depth of penetration in the osteotomy site are controlled by these guides. This includes two designs, i) cast based surgical guide and ii) CAD-CAM based surgical guide.

➢ *Cast based surgical guide*

In this technique, initially bone volume is measured using techniques such as bone sounding and periapical radiographs which then are amalgamated, and the data of the implant analog platform positions are transposed onto a surgical guide which usually is useful for conventional flapless guided surgery. This allows the procedure to be less invasive and to have precise implant and prosthesis placement.

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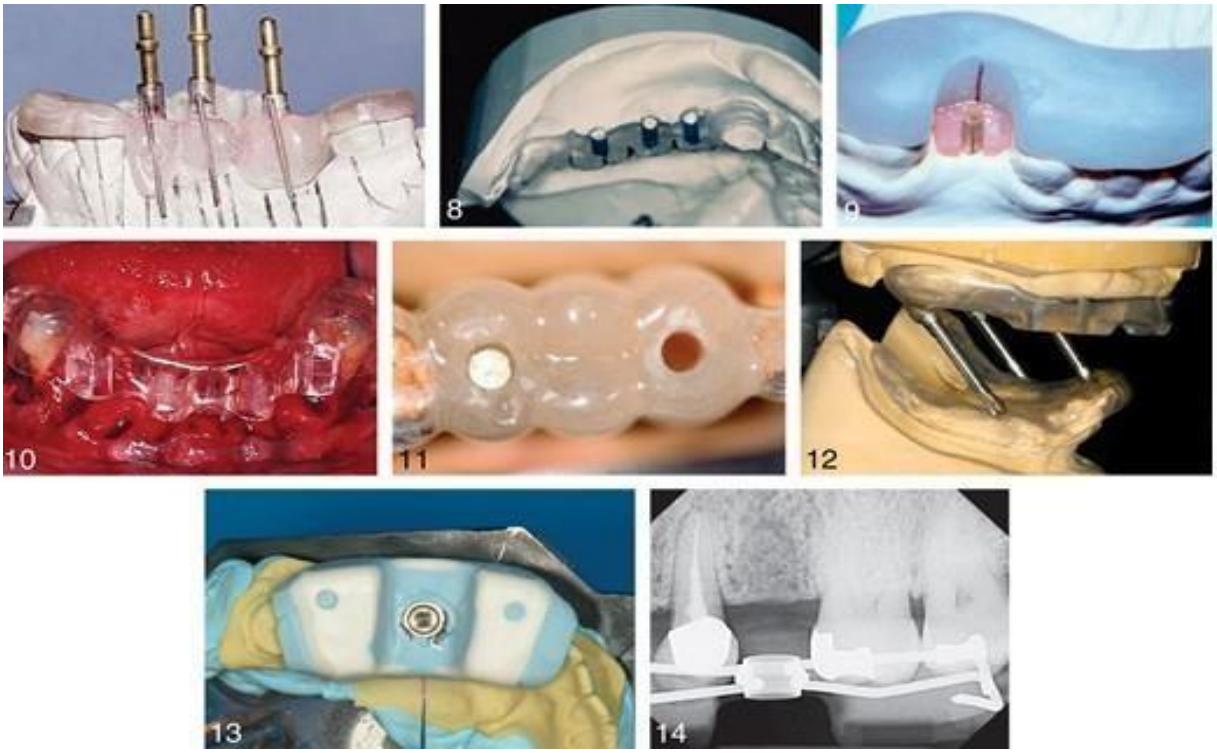

Fig 2 - Cast based guide

➢ *CAD-CAM based Implant Surgical Guide*

CAD CAM-based guides exhibit remarkable precision due to their incorporation of a virtual 3D visualization of the patient's bone structure. This comprehensive view highlights potential errors and complications, allowing for preemptive measures before the surgery.

Consequently, this technology aids in sidestepping the need for bone augmentation procedures, facilitating flapless techniques, and actively guiding and governing the three-dimensional movement of the drills within the osteotomy site.

Fabrication of this kind of guides includes the following steps:

- Fabrication of radiographic template
- Dual scan technique is done (DICOM data of CBCT and STL file of digital impressions / scan of the cast)
- Superimpose both the files using implant planning software
- Visualize and plan prosthetically driven implant placement
- Fabrication of stereolithographic drill guide


Fig 3 - CAD-CAM based guide (consists of guide sleeves and anchor pin holes)

While digital implantology offers numerous benefits, it can potentially introduce complications stemming from issues like an ill-fitting guide causing drill wobbling, inaccurate measurements of the necessary implant due to CBCT imprecision, flaws in the scan appliance, or the clinician's misjudgment.

The following is a compilation of factors that may contribute to complications in the realm of digital implantology.

- Wrong superimposition of the scan
- Incorrect judgement of the drill hole diameter
- Incorporation of wrong metal cylinder
- Improper understanding of the guided surgery software leading to errors
- Inaccurate CBCT and digital impressions
- Improper curing of the resin
- Uncured resin left in the guide

- Improper orientation of the guide
- Resin shrinkage
- Improper understanding of the drilling protocol of the respective system

A surgical guide can be an excellent choice for achieving minimally invasive procedures, but it requires careful consideration and precision during implant planning and the 3D printing process.

Computer aided guided surgery is divided into 2 types based on the protocol followed

- Static guided surgery
- Dynamic navigation

IV. STATIC GUIDED SURGERY

This approach is typically employed in cases requiring full mouth rehabilitation, utilizing a CAD-CAM- based surgical guide template to enhance precision during drilling and reduce the risk of lateral errors. While it offers several advantages, it also comes with certain limitations.

One of the limitations pertains to the patient's mouth opening, which should ideally be sufficient to accommodate the surgical guide comfortably. Additionally, once the guide is fabricated, the surgery must be performed within a two-week timeframe to mitigate the potential issue of resin shrinkage. It's worth noting that in this static approach, adjustments to implant size or length cannot be made during surgery if necessary.

Despite these limitations, complications in the static approach can be minimized through careful patient selection and meticulous implant planning.

V. DYNAMIC NAVIGATION

Dynamic navigation in implant dentistry involves using virtual implant planning based on CBCT scans and real-time tracking of drills and the spatial position of the implant during surgery. This advanced technique offers several significant advantages. Firstly, it enables precise monitoring of each step of the drilling protocol, ensuring accurate implant placement. Additionally, the 3D position of the implant is constantly displayed on a screen for real-time visualization. The larger working area provided by dynamic navigation allows for ample irrigation during the procedure, contributing to better cooling effect.

One notable benefit is the elimination of the need for a physical surgical guide, which is typically required in static guided surgery. This not only simplifies the process but also allows clinicians to take on cases with patients who have limited mouth opening. As a result, dynamic navigation can save time compared to traditional static guided surgery.

However, it's essential to note that dynamic navigation requires a thorough understanding of the system, not only by the clinician but by the entire surgical team. This technology-driven approach may not be cost-effective compared to conventional methods, making it important for practitioners to weigh the benefits against the associated costs and training requirements.

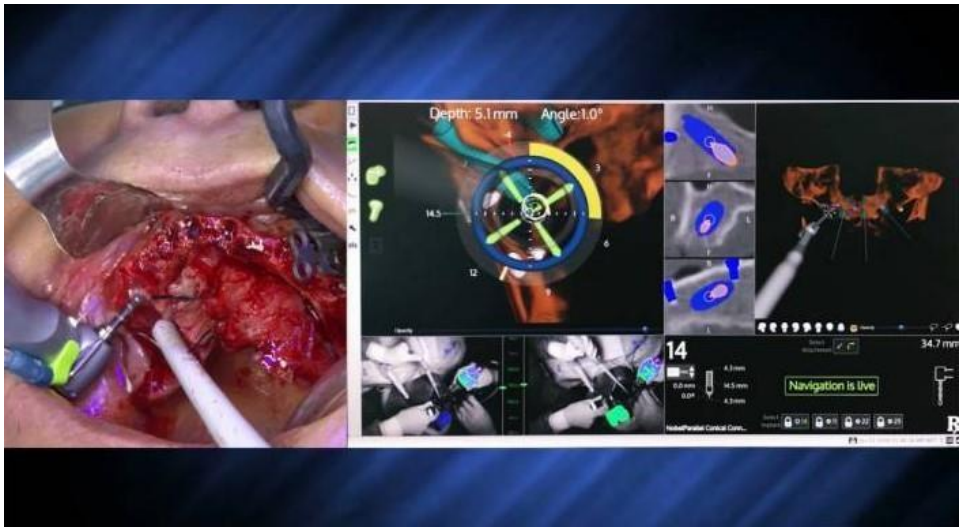

Fig 4 - Dynamic navigation approach - live navigation of the drills

VI. CONCLUSION

Freehand surgery is a versatile approach suitable for single implant procedures and situations where a sudden change in the treatment plan is necessary during guided surgery. In cases where complications arise during guided surgery, such as guide breakage, improper fit, or incorrect implant size sleeve, freehand surgery can be employed to address and complete the procedure. Additionally, when limited mouth opening is observed and bone augmentation is required, freehand surgery may be the preferred method.

On the other hand, guided surgery is highly recommended for full-mouth rehabilitation cases where no reliable reference is available. This technique involves virtual planning of the implant position and the use of a surgical guide, which can streamline the surgical process and enhance precision.

Both freehand and guided surgery approaches have their unique advantages and disadvantages. Choosing the appropriate method for a specific case is crucial to maximize the benefits of each technique.

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