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Pre surgical Mock-up driven design of implant surgical guide: A newer approach of surgical simulation

[1]Rachana Kb, MDS, Reader, Department of Prosthetic Dentistry, VIMS Dental College, Bellary

[2]Santosh Nelogi, MDS, Reader, Department of Prosthetic Dentistry, KAHER (KLE UNIVERSITY) KLE V.K Institute of Dental Science, Belgaum- 590010, Karnataka, India.

[3]Maheshwari Nelogi, BDS, Lecturer, Department of Prosthetic Dentistry, KAHER (KLE UNIVERSITY) KLE V.K Institute of Dental Science, Belgaum-590010, Karnataka, India.

Corresponding Author: Santosh Nelogi, MDS, Reader, Department of Prosthetic Dentistry, KAHER (KLE UNIVERSITY) KLE V.K Institute of Dental Science, Belgaum- 590010, Karnataka, India.

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Abstract

Rehabilitation of prosthodontic implants remains among the most complex rehabilitative challenges due to the most common problems with the lack of adequate treatment planning. The location, angulation, diameter of the implant and the length of the implant must be determined before the surgery is planned.

This article discusses the novel technique of pre-surgical simulation of the implant site and the evaluation of the implants Position, angulation and complexity of the procedure in the study model.

Introduction

Rehabilitation of prosthodontic implants remains amongst the most complex therapeutic challenges due to one of the most serious challenges with the lack of adequate treatment planning. The position, angulation, diameter of the implant and the length of the implant must be determined before the surgery is anticipated.

A review through the literature[1 -15] reveals several implant surgical guide for the placement of an implant, but the techniques mentioned do not guide the surgeon to simulate the surgical procedure l to the full depth of an implant site at determined angulation. They only mention about the placement of the implant and provide little or no information about the diameter of implant and abutment angulation required at proposed implant site.

Surgical guides made up the information procured from panoramic or peri apical images to a degree based on 2-dimensional imaging, which provide little or no information on the diameter of the implant and the abutment angulation necessary at the suggested implant site. [16-26] .

Computed tomography (CT) has frequently been used as an imaging system for the pre-operative assessment of implant positioning.[27-33] The assessment of available bones provides improved bone density determination and location of anatomical structures, and provides information on the trajectory of implant placement. [34]

With the advancement of the Implant Imaging System, the software-guided position of the implant is often used to direct the surgeon to place the implant in the intended position with the correct angulation. Although useful, CT-guided surgical guides turn out to be expensive and not feasible for all patients.

The next coherent step is to construct a surgical guide that in blend with a computed tomography (CT). This would illustrate the tangible implant site and the path of the implant position. The purpose of this article is to describe novel surgical guide fabricated by with the help of a computed tomography (CT) As an alternative.

Materials and Methods

Make maxillary and mandibular over extended impressions with elastomeric impression material (Aquasil Ultra Soft Putty; Aquasil Ultra LV Wash; Dentsply International, Milford, Del) and pour casts with Type III dental stone. (Kalastone; Kalabahi ltd, Mumbai, India).

The diagnostic C.T scans of the patient is subjected for dolphin implant planer (or any implant planner), Precise and appropriate placement of a dental implant with proper angulation is planned.

Preparation of mock up model

Using pin index system ,removable die of the proposed implant site is prepared. (Fig-1)

The trajectory of the planned cross-section implant of the proposed implant site printing is obtained on a clear cellophane sheet without any magnification error (Fig-2) and is then clearly defined by a conversion procedure to the corresponding removable dies of the proposed implant site (Fig-3)

The central line delineated on to the respective removable dies of the proposed implant site at the time of planning of implant to determine the correct implant angulation. For every implant site, the vertical configuration of line presents the original spot, close to which position and angulation of implant is planned.

Mockup osteotomy performed on corresponding removable dies according to marked bony architecture.

Analyzing rods are aligned with the long axis of the marked bony architecture, which centered over the outline representing the location, diameter of implant and angulation for implant placement. (Fig-4)

The vertical alliance of analyzing rod presents the original position of implant at that particular situation. (Fig-3 , Fig -4)

At this angulation of analyzing rod ,the round stainless steel tube of length 6mm and with inner diameter of 2 mm is positioned over the analyzing rod, lightly contacting the cast. When tube position and required abutment angulation is conformed, auto polymerizing acrylic is added incrementally to stabilize the tube.

When resin is polymerized, the surgical guide is recovered carefully from the mould to evade any damage or alteration of angulation of the stainless steel tube and sterilized by using cold sterilization.

Discussion

Prosthetically guided implant placement often involves the use of X-rays and surgical guides for implant placement. [35-36] Most of the surgical guides provide data on the mesiodistal location of the implant, but no data on its angulation, while others provide data on location and angulation, but not on depth. With the advancement of computer engineering and software-guided implant placement, it is often used to guide the surgeon in

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positioning the implant at the intended location, at the correct depth, and with the proper angulation, which is not workable for most patients.

Surgical guides, combined with clinical planning information, provide accurate guidance for implant positioning. Petersson et al 37 and Weinberg38 documented the need for pre - operative C.T. in approximately two thirds of patients for appropriate implant orientation, even after panographic evaluation.

The surgical stent discussed in the article helps the surgeon perform a pre-surgical mock-up of the model and shows a comprehensive three-dimensional relationship with the proposed implant site, also guides the surgeon to maintain a pre-determined angulation at the proposed implant site that precludes any fenestration during surgery and ensures that the implant is correctly aligned with respect to the planned restoration.

The surgical guide with detailed three dimensional position of stainless steel tube functions as a precise surgical osteotomy guide. The osteotomy prepared in the bone with surgical guide has the same orientation as the mock up osteotomy in the mold and is coherent with the planned prosthetic angulations.

The surgical guide also allows the pilot drill to be placed up to the required length along one specific path, avoiding the risk of change in angulations in subsequent drilling and thereby reducing the inadvertent eccentric enlargement of the implant site. The novel technique consists of mock up osteotomy on cast, which helps the restorative dentist to know the desired abutment angulation required for the placement of esthetic restorations.

The above approach would be used for single or multiple implant placements. In multiple implant placements, this technique enables the operator to ensure parallelism between the implants and to achieve the desired inclination of the implant in accordance with the bone structure.

When a variance between the premeditated prosthetic angulation and the residual bone is established during cross-section imaging, the analytical rod is changed and the stainless steel tube is reoriented. The planned implant placement in competition with CT imaging is a relatively economical way of assessing bone quality and, at the same time, provides data on the trajectoryfor the placement of the dental implant in three dimensions.

The advantage of this technique is that it is simple and easy to fabricate and uses the material that are inexpensive and readily available. When the surgeon uses this surgical guide for placement of implant, the implant is placed as per the pre-determined position and hence helps the restorative dentist in planning the restoration. Since the implant location and the desired abutment angulation are known, a provisional restoration can be fabricated and then that it can be cemented at the time of surgical operation if an immediate provisional restoration is preferred.

Conclusion

The assembly of surgical guides in competition with a CT scan makes the implementation of dental implant placement a more accurate and reliable routine, and provides information on the trajectory of the location of the dental implant. The novel surgical guide referred to in the article makes it possible to evaluate not only the available bone height and width, but also the angulation and describe the actual implant site and angulation on removable die and provide data about the trajectory of the position of the dental implants.

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Legend Figures

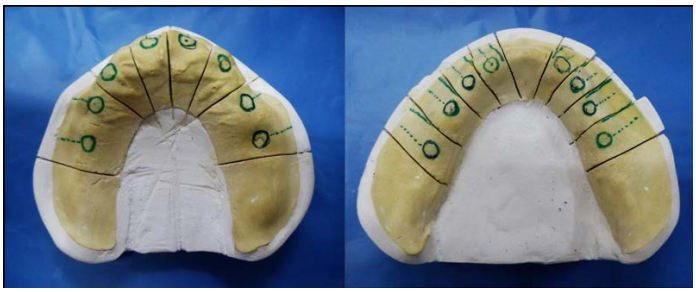

Fig.1: Die with mock up osteotomy site for implants

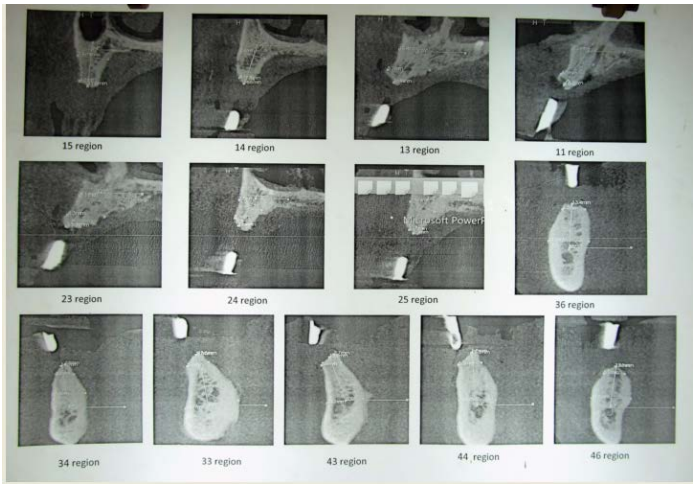

Fig. 2: The trajectory of the planned implant cross-sectional image of the proposed implant.

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Fig.3: Proposed implant delineated on to the respective removable dies.

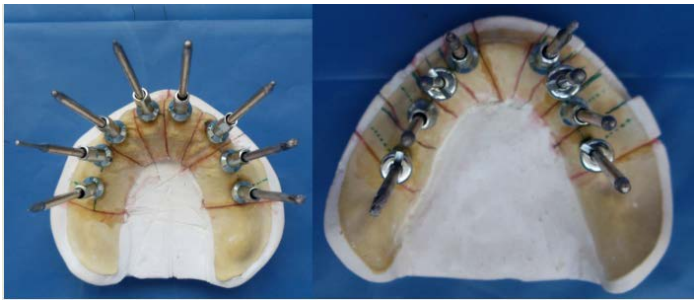

Fig. 4: Analysing rod in position along the long axis of predicted implant location.

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