REVIEW ARTICLE

Changing Trends in Guided Implant Systems

Sajna Oommen[1], Arun Jacob Thomas[2]

ABSTRACT

Despite significant advances in devices and techniques, placement of dental implants at a correct position as per the esthetic, biological, and functional perspective still remains a challenge because the trajectory of implants is seldom consistent with that of natural teeth due to the bone loss that follows extraction. In most of the times, the placement of implant is not as accurate as intended. Even a minor variation in comparison to ideal placement causes difficulties in fabrication of final prosthesis. Failures arise as a result of lack of consideration of the superstructure during presurgical planning. Thus, to establish logical continuity between diagnosis, prosthetic planning, and surgical phases, the use of transfer device is essential. Such a transfer device is termed as surgical guide template. It not only assists in diagnosis and treatment planning but also facilitates proper positioning and angulation of the implants in the bone. Moreover, restoration-driven implant placement accomplished with a surgical guide template can decrease clinical and laboratory complications. Hence in response to increasing demand for dental implants and perceived complexity in implant placement has resulted in development of newer and advanced techniques for the fabrication of these templates.

Keywords: Computer-assisted design and manufacturing, Guided implant, Surgical guide template.

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INTRODUCTION

Indications of dental implant therapy have expanded with change in implant shapes, sizes, materials, coatings, and technological advances such as guided tissue regeneration and immediate loading concepts. Research aiming at improving the design of implant's surface treatment such as increasing bone-to-implant contact ratio with plasma sprayed surface, ion sputtering coating, anodized surface, sandblasted and acid etched, hydroxyapatite coating, and biochemical surface, aids in controlling the tissue implant interface with molecules delivered directly to the interface. Earlier dentists were intended to place implants where the greatest amount of bone was present, with less regard to placement of final definitive restoration. In most of the times, the placement of implant is not as accurate as intended.[1-4] Even a minor variation in comparison to ideal placement causes difficulties in fabrication of final prosthesis. Failures arise as a result of lack of consideration of the superstructure during presurgical planning. Thus, to establish logical continuity between diagnosis, prosthetic planning, and surgical phases, the use of transfer device is essential. Such a transfer device is termed as surgical guide template. It not only assists in diagnosis and treatment planning but also facilitates proper positioning and angulation of the implants in the bone. Moreover, restoration-driven implant placement accomplished with a surgical guide template can decrease clinical and laboratory complications.[5] Hence in response to increasing demand for dental implants and perceived complexity in implant placement has resulted in development of newer and advanced techniques for the fabrication of these templates.

[1,2]Senior Lecturer

[1]Department of Prosthodontics, Noorul Islam College of Dental Science, Thiruvananthapuram, Kerala, India

[2]Department of Oral Pathology and Microbiology, Noorul Islam College of Dental Science, Thiruvananthapuram, Kerala, India

Corresponding Author: Dr. Sajna Oommen, Senior Lecturer, Department of Prosthodontics, Noorul Islam College of Dental Science, Thiruvananthapuram, Kerala, India. e-mail: oommensajna@gmail.com

USES OF SURGICAL GUIDE

1. Guidance of osteotomy drills at correct position, angulation, and depth.
2. Guidance of implant fixtures at correct position, angulation, and depth.
3. Guidance of amount of bone reduction or bone harvesting if necessary (both soft tissue and hard tissue harvesting).[6-9]

There are three types of surgical guide:

1. Bone supported,
2. Mucosa supported, and
3. Tooth supported.

1. Bone supported guides - They are used in partially edentulous sites and completely edentulous sites. When used in partially edentulous sites, it should possess at least 3 cm of supporting bone or three teeth would need replacement. Bone guides are especially used when edentulous sites possess thin bone.

2. Mucosa supported guides - It is used in fully edentulous sites. Advantage - less or no tissue reflection is required, so less post-operative discomfort.
3. Tooth-supported guides - Minimum three stable teeth should be present to support the guide during surgery.[10-14]

The fabrication of the surgical guide templates is then based on one of the following design concepts: [15]

1. Non-limiting design
2. Partially limiting design
3. Completely limiting design.

Non-limiting Design

This design provides only an indication, without angulation, to the surgeon as to where the proposed prosthesis is in relation to the selected implant site. It indicates 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 designs, 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. Techniques based on this design concept involve fabrication of a radiographic template, which is then converted into a surgical guide template following radiographic evaluation.

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. As the surgical guides become more restrictive, less of the decision-making and subsequent surgical execution is done intraoperatively. This includes two popular designs: Cast-based guided surgical guide and computer-assisted design and manufacturing (CAD/CAM) based surgical guide.[16,17]

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 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 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 using wires that are used to create a framework around the teeth. Vinyl polysiloxane occlusal registration material is used to form the superstructure.[18]

CAD/CAM-BASED SURGICAL GUIDE

To overcome the limitations associated with conventional radiographic surgical template, computer-generated surgical template has been evolved. CAD/CAM technology uses data from computer tomography (CT) scan to plan implant rehabilitation. CT images are converted into data that are recognized by CT imaging and planning software. This software then transfers this presurgical plan to the surgery site using stereolithographic drill guides. Utilizing the latest scanning, CAD/CAM and manufacturing technologies, the dental team is able to develop individualized dental restoration with high accuracy and precision.[19]

CONCLUSION

To achieve a successful final treatment outcome, a position at least equivalent to the maximum deviation of the implant placement is necessary. This has been best achieved clinically with the help of a computer-aided surgical guide. However, compared to the conventional technique, limitation with computer-aided implant surgery requires substantially greater investment and effort. Based on clinical data, image guidance is not required for cases with sufficient anatomic orientation and bone height. Computer-aided planning and image guided surgery can be carried out when implant positioning is to be precisely executed and when safe positioning of implants with optimal use of available bone, and whenever, CT scan is recommended as a diagnostic means.

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