Original Research Paper

VOLUME-6 | ISSUE-3 | MARCH - 2017 • ISSN No 2277 - 8179 | IF : 4.176 | IC Value : 78.46

Guided implant surgery- a boon for Dentistry!

Dental Science

KEYWORDS: Guided implant surgery, surgical guide, accuracy, implant

Dr. Grishmi Niswade	Senior lecturer, Department of Periodontology, Swargiya Dadasaheb Kalmegh Smruti Dental college and hospital, Nagpur
Dr. Mitul Mishra	Senior lecturer, Department of Periodontology, Swargiya Dadasaheb Kalmegh Smruti Dental college and hospital, Nagpur
Dr. Deepti Gattani	Head of Department and Professor, Department of Periodontology, Swargiya Dadasaheb Kalmegh Smruti Dental college and hospital, Nagpur
Dr. Girish Bhutada	Professor, Department of Periodontology, Swargiya Dadasaheb Kalmegh Smruti Dental college and hospital, Nagpur

ABSTRACT

Recently, dental implants are gaining increasing acceptance from patients as a solution for tooth loss. Early implant surgeries were performed with petite prosthetic considerations and implants were positioned where bone was available. Due to developments and advances in dental implants with regard to design and surface coatings, the success rate has increased to up to 95%. Computed tomography (CT) assisted implant placement augments the accuracy and quality of implant placement. Prosthetically driven implantology is followed currently to achieve an ideal crown position and CT helps to achieve this goal.

Introduction

Edentulism is the state of having lost all of one's natural teeth.[1] Native Americans have the highest predicated rate of edentulism based on oral examination (24%), followed by African Americans (19%), Caucasians (17%), Asians (14%), and Hispanics (14%).[2] The most commonly accepted treatment modality for edentulism was the use of fixed partial dentures. The disadvantages with fixed partial dentures include damage to the tooth and pulp, secondary tooth decay and increased plaque accumulation. Dental Implants have revolutionized the treatment for fixed replacement of missing teeth. All the disadvantages of fixed partial denture were overcome by Dental Implants. However, successful implant placement is a technique sensitive procedure and also the cost of its treatment limits its use in clinical practice. Newer techniques like 3 D printing and Implant guided surgery limits the difficulty and complication associated with surgical implant placement. Therefore, dental implants have now become the most accepted mode of therapy for edentulism by the patients.

A clinician practising implant dentistry faces many complications and dares. These complications can affect the treatment outcome leading to a compromised result. One of the most common complications is implant malpositioning which can be prosthetic or surgical. Malpositioned implants can also lead to a byzantine and costly restorative process, screw loosening and fractures and compromised aesthetic outcomes. Therefore implant dentistry requires a detailed and precise planning, understanding, accuracy and sound clinical judgement.

Prosthetically driven implant surgery has been a subject of fundamental interest to the dental profession. Correct implant positioning has obvious advantages, such as favourable aesthetic and prosthetic outcomes, long-term stability of peri-implant hard and soft tissues as a result of simple oral hygiene and the potential to ensure optimal occlusion and implant loading[3-4]. Various requirements, such as the desired interimplant distance, tooth-to-implant distance, implant depth and other aspects, have made virtual implant planning an important tool when aiming for optimal treatment success[5-6].

The introduction of cone-beam computerized tomography scanning, in combination with three dimensional imaging tools, has led to a major breakthrough in virtual implant treatment planning. Conebeam computerized tomography scanners use lower radiation doses compared with conventional computerized tomography scanners. In combination with implant planning software, the use of cone-beam computerized tomography data has made it possible to plan virtually the ideal implant position, while taking the surrounding vital anatomic structures and future prosthetic requirements into consideration.

What is Guided Implant surgery?

Guided implant surgery involves the usage of software which enhances the planning of dental implant placement using the patient's CT scan images. It is based on the use of CT images to perform implant surgery simulation. This simulation consists of virtual implant placement taking into consideration the anatomic variations as well as the prosthesis. Once a proper surgical and restorative implant plan is selected, a computer guide is fabricated and used during the surgery. A specialized surgical kit and surgical template are pre-requisites for guided implant surgery. Generally, two types of guided implant surgery protocols – static and dynamic – are described in the literature. The static approach refers to the use of a static surgical template. This reproduces the virtual implant position directly from computerized tomographic data to a surgical guide, which does not allow intra-operative modification of the implant position[9,10].

There are two protocols for guided implant placement- static and dynamic. A static surgical template is used in static protocol which uses the replica of the virtual position of implant from the CT images to a surgical template with the help of a drilling machine. [14] Intra-operative position of dental implant cannot be modified in the static approach. The dynamic protocol for guided implant surgery is also known as navigation, which also duplicates the virtual implant position from CT images and allow intra-operative modification of implant position. These navigation systems use motion tracking technology that permits real time tracking of dental drill and patient throughout the surgery.

Implant planning software

Cone beam computed tomography produces images in a DICOM format, that are read by the implant planning software which converts them into 2-D or 3-D images which can be used for implant planning. A software was introduced in 1998 by Columbia scientific, inc (Glen Burnie MD, USA) which converted the CT images into reformatted cross-sectional axial images, which could be used for implant planning. In 1991, a software ImageMaster-101 was introduced which allowed graphic images to be placed on cross sectional images. In 1993, Columbia Scientific introduced the first version of software named Simplant, which allowed placement of virtual implants of precise measurements on cross-sectional, axial and panoramic views of CT images. This software was modified in 1999 named as Simplant 6.0 which allowed 3-D reformation of the

image surface. In 2002, Materialise (Leuven, Belgium) purchased Columbia scientific and introduced the technology of drilling osteotomies to an exact depth and angulation through a surgical guide. Nowadays various implant companies have launched their software and surgical guides for implant planning.[14]

Indications of Guided Implant Surgery[8]

- Limited surgical spaces
- Angled implants (such as "All on 4" technique)
- Immediate implant placement and provisionalisation
- Multiple adjacent implants
- Orthodontic anchorage

Guided Implant surgery kit

Various manufacturers for Guided Implant surgery

	Manufacturer	Product
Guided surgery kit	Cybermed	In2Guide™
	Nobel Biocare	NobelGuide™
	Biomet 3i	Navigator™
	Straumann	Guided Surgery™
	Astra	Facilitate™
	Densplay	ExpertEase™
	Materialise	SAFE SurgiGuide kit™
Planning software	Cybermed	In2Guide™
	Nobel Biocare	Procera
	Materialise	Simplant
Surgical Template	Cybermed	In2Guide™
	Nobel Biocare	NobelGuide™
	Materialise	SurgiGuide™

Components of Guided Implant Surgery kit

1. **Anchor pin/ anchor drill**- Ensures the surgical template is firmly fixed to the oral cavity. Drilling is done with the Anchor Drill then Anchor Pin is inserted to place the surgical template.
2. **Tissue punch**- Used to remove tissue during flapless implant surgery.
3. **Drill guide**- Connects to the sleeve and guides the drill into the planned angle and direction. There are several drill guides to accommodate different drill sizes.
4. **Drill**- Guided by the Drill guide, a drill has a self-stopper allowing the drill depth to be controlled.

Procedure for surgery

Prior to surgery, a surgical template is prepared. The template is properly disinfected and all surfaces are made smooth to avoid trauma to the soft tissue. After proper anaesthesia, template is placed and drilling is started with anchor drill and anchor pin is placed. Tissue punch is used for removal soft tissue. After removal of soft tissue, surgical template is again placed and drilling is started with sequential drill guide and drills. Followed by drilling, guided surgery mount is attached to the implant. Implants of appropriate sizes are placed. A Provisional restoration is attached if immediate loading is to be done.

Types of Surgical Guides

Surgical guides are divided according to the type of support or in the way they are positioned.[14]

- Tooth supported surgical guides- the surgical guide is placed on remaining teeth
- Mucosa supported surgical guides- the surgical guide is positioned on top of mucosa. This is used in cases of edentulous patients.
- Bone supported surgical guides- the surgical guide is placed on bone after raising a mucoperiosteal flap.
- Special supported (mini) implant, pin supported surgical guides- the surgical guide is attached to implants placed before or during the actual surgery.

A systematic review from the 5th International Team for Implantology Consensus Conference[10] concluded that, compared with other types of guide, the bone-supported surgical guides showed the highest inaccuracy.

Flapless or flap surgery?

Minimally invasive procedures are vital nowadays to prevent tissue trauma and provide comfort to the patient. Blood circulation is preserved in the soft tissues which will ultimately affect the soft tissue architecture after the surgery.[17] Guided implant surgery involves a minimally invasive flapless technique where a dental implant is installed through the mucosal tissues without reflecting a mucoperiosteal flap or a minimal reflection of flap. Implants can be installed either freehand or by using a surgical guide. Studies have shown that a flapless approach results in reduced bone loss and greater papilla regrowth, which enhances the aesthetic outcome of dental implants. [18] Also, the periosteum is intact because of minimal or no flap reflection. This preserves the blood supply and cells with osteogenic potential around the alveolar bone.[19] Post-operative morbidity and discomfort is reduced with flapless surgery[20,21] and is therefore more preferred by the patients.[22,23] Other advantages of flapless surgery include that this approach is beneficial in medically compromised patients such as those on anticoagulants and bisphosphonates, a provisional restoration can be placed immediately after surgery thus enhancing function and aesthetics.[17]

Advantages of Guided implant surgery

- Guided Implant surgery provides an accurate, safe and predictable method of surgery.
- The duration of surgery is reduced.
- Healing time is also reduced due to flapless surgery.
- Smaller incisions with less bleeding and pain.
- Immediate loading can be done.
- Use of bone graft is minimized.
- Correct implant positioning has favourable prosthetic and aesthetic outcomes, long term stability of peri-implant hard and soft tissues.
- Correct positioning of the implant enables the final prostheses to be optimally designed and makes it possible to devise and fabricate retrievable screwretained suprastructures, thereby avoiding non retrievable cemented restorations.[7]

Consequently, all of these factors may contribute to the long-term success of dental implants.

Disadvantages of Guided Implant surgery

- Expensive equipment for CT, surgical kit and surgical template is needed.
- Underlying morphology of alveolar bone cannot be checked during flapless surgery.
- Planning of the surgery takes longer.
- Need to learn how to operate planning software.
- Difficult to deal with unexpected situations during surgery.
- Due to the bulk of the template and instrumentation, posterior implant placement is often difficult

Newer advances

Dental technology has advanced rapidly which also has an impact on Guided implant surgery. Cone beam computed tomography which is advancement on CT scan, provides the advantage of improved data procurement and processing. This significantly affects the treatment outcome of virtual implant planning. Also, intra-oral scanners have been developed, which along with CBCT scanning and virtual implant placement software, provides a complete three dimensional view of the oral cavity. Newer planning software permits a future digital wax up which will give an idea to the clinician as to what will be the prosthetic outcome and what can be done to improve it. There are developments in the method of fabrication of surgical guides which involve milling and three dimensional printing. All such advances further enhance the accuracy and precision of implant placement.[14]

VOLUME-6 | ISSUE-3 | MARCH - 2017 • ISSN No 2277 - 8179 | IF : 4.176 | IC Value : 78.46

Conclusions

Guided implant surgery has the advantages of a better aesthetic outcome because of the minimally invasive approach, reduced treatment time and improved accuracy. Healing is enhanced due to minimally invasive type of procedure. However, it cannot be concluded that guided implant surgery is better than conventional procedures in terms of treatment outcome, morbidity and efficiency. The imprecision arises mainly due to improper data acquisition and its transformation into surgical guides. But nowadays availability of digital impressions can be of definite help in this aspect. Still there is no substitute to clinical judgement, treatment planning and surgical skills. Long term studies and randomized controlled clinical trials are required to understand the outcomes and efficiency of guided implant surgery.

References

1. Sussex P.V. Edentulism from a New Zealand perspective—A review of the literature. N. Z. Dental J. 2008; 104:84–96.
2. Karl Peltzer et al. Prevalence of Loss of All Teeth (Edentulism) and Associated Factors in Older Adults in China, Ghana, India, Mexico, Russia and South Africa. Int J Environ Res Public Health. 2014 Nov; 11(11): 11308–11324
3. Buser D, Bornstein MM, Weber HP, Gr€utter L, Schmid B, Belser UC. Early implant placement with simultaneous guided bone regeneration following single-tooth extraction in the esthetic zone: a cross-sectional, retrospective study in 45 subjects with a 2- to 4-year follow-up. J Periodontol 2008: 79: 1773–1781.
4. Buser D, Halbritter S, Hart C, Bornstein MM, Gr€utter L, Chappuis V, Belser UC. Early implant placement with simultaneous guided bone regeneration following singletooth extraction in the esthetic zone: 12-month results of a prospective study with 20 consecutive patients. J Periodontol 2009: 80: 152–162.
5. Hermann JS, Schoolfield JD, Schenk RK, Buser D, Cochran DL. Influence of the size of the microgap on crestal bone changes around titanium implants. A histometric evaluation of unloaded non-submerged implants in the canine mandible. J Periodontol 2001: 72: 1372–1382.
6. Tarnow DP, Cho SC, Wallace SS. The effect of inter-implant distance on the height of inter-implant bone crest. J Periodontol 2000: 71: 546–549.
7. Linkevicius T, Puisys A, Vindasiute E, Linkeviciene L, Apse P. Does residual cement around implant-supported restorations cause peri-implant disease? A retrospective case analysis. Clin Oral Implants Res 2013: 24: 1179–1184
8. Valente F, Schiroli G, Sbrenna A. Accuracy of computeraided oral implant surgery: A clinical and radiographic study. Int J Oral Maxillofac Implants. 2009 Mar-Apr; 24(2):234-42.
9. Jung R, Schneider D, Ganeles J, Wismeijer D, Zwahlen M, H€ammerle CH, Tahmaseb A. Computer technology applications in surgical implant dentistry: a systematic review. Int J Oral Maxillofac Implants 2009: 24: 92–109.
10. Tahmaseb A, Wismeijer D, Coucke W, Derksen W. Computer technology applications in surgical implant dentistry: a systematic review. Int J Oral Maxillofac Implants 2014: 29:25–42.
11. Branemark, P.I., Hansson, B.O., Adell, R., Breine, U., Lindstrom, J., Hallen, O. & Ohman, A. (1977) Osseointegrated implants in the treatment of the edentulous jaw. Experience froma 10-year period. Scandinavian Journal of Plastic and Reconstructive Surgery and Hand Surgery 11 (Suppl. 16): 1– 132.
12. Schnitman, P.A., Rubenstein, J.E., Woehrle, P.S., DaSilva, J.D. & Koch, G.G. (1988) Implants for partial edentulism. International Journal of Oral Implantology 5: 33–35.
13. Di Giacomo, G.A., Cury, P.R., de Araujo, N.S., Sendyk, W.R. & Sendyk, C.L. (2005) Clinical application of stereolithographic surgical guides for implant placement: preliminary results. Journal of Periodontology 76: 503–507.
14. JAN D'HAESE et al. Current state of the art of computer-guided implant surgery. Periodontology 2000, Vol. 73, 2017, 121–133
15. Schneider D, Ganeles J, Wismeijer D, Zwahlen M, H€ammerle CH, Tahmaseb A. Computer technology applications in surgical implant dentistry: a systematic review. Int J Oral Maxillofac Implants 2009: 24: 92–109.
16. Tahmaseb A, Wismeijer D, Coucke W, Derksen W. Computer technology applications in surgical implant dentistry: a systematic review. Int J Oral Maxillofac Implants 2014: 29: 25–42.
17. Sclar AG. Guidelines for flapless surgery. J Oral Maxillofac Surg 2007: 65: 20–32.
18. Cosyn J, Hoogde N, De Bruyn H. A systematic review on the frequency of advanced recession following single immediate implant treatment. J Clin Periodontol 2012: 39: 582–589.
19. Staffileno H. Significant differences and advantages between the full thickness and split thickness flaps. J Periodontol 1974: 45: 421–425
20. Becker W, Goldstein M, Becker BE, Sennerby L, Kois D, Huipel P. Minimally invasive flapless implant placement: follow-up results from a multicenter study. J Periodontol 2009: 80: 347–352.
21. Fortin T, Bosson JL, Isidori M, Blanchet E. Effect of flapless surgery on pain experienced in implant placement using an image-guided system. Int J Oral Maxillofac Implants 2006: 21: 298–304.
22. Arisan V, Karabuda CZ, Ozdemir T. Implant surgery using bone- and mucosa supported stereolithographic guides in totally edentulous jaws: surgical and post-operative outcomes of computer-aided vs. standard techniques. Clin Oral Implants Res 2010: 21: 980–988.
23. Van de Velde T, Glor F, De Bruyn H. A model study on flapless implant placement by clinicians with a different experience level in implants surgery. Clin Oral Implant Res 2008: 19: 66–72.