Clinical outcomes of flapless implant surgery using a handpiece driven stereolitho-graphic surgical guide

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Computer aided planning and stereolitography allows clinicians to transfer the virtual implant positions to patient via surgical guide. Studies were presented using stereolitography recently, however most of were specifique to an implant brand or type only. Hence, drill guidance and multiple numbers of guides inherits certain limitations and risks. A new type of surgical guide (Ötede®, Aytasarim, Ankara, Turkey) eliminating drill guidance was presented in this study.

_Material and methods

Following the anamnesis, clinical and radiologic examinations of the patients were completed. Patient consent form was taken for the use of a stereolitographic surgical guide and flapless surgery. Five patients were included for this study. Scan prosthesis were fabricated using duplication method and digital volumetric tomography (DVT) were used for 3-D imaging of the patient's jaw anatomy. Implants were planned on the software according to the teeth and alveolar anatomy visualized on DVT images.

Surgical guide and handpiece attachment were fabricated with a fast prototyping machine. A triangular lock mechanism adapted on surgical guide and handpiece were used for guiding the osteotomy drills

Table 1_Distortion values (mm) in periapical, panaromic and tomographic X-rays (Sonick et al. 1994)

	Mean distortion	Maximum detected distortion
Periapical	1.9	5.5
Panaromic	3.0	7.5
Computerised Tomography	0.2	0.5

Fig. 1_(a) Surgical guide and **(b)** individual male triangular lock for the handpiece.

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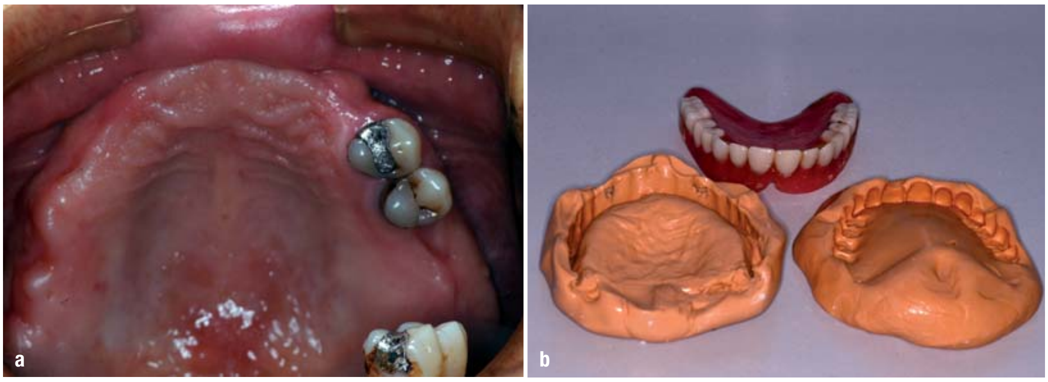
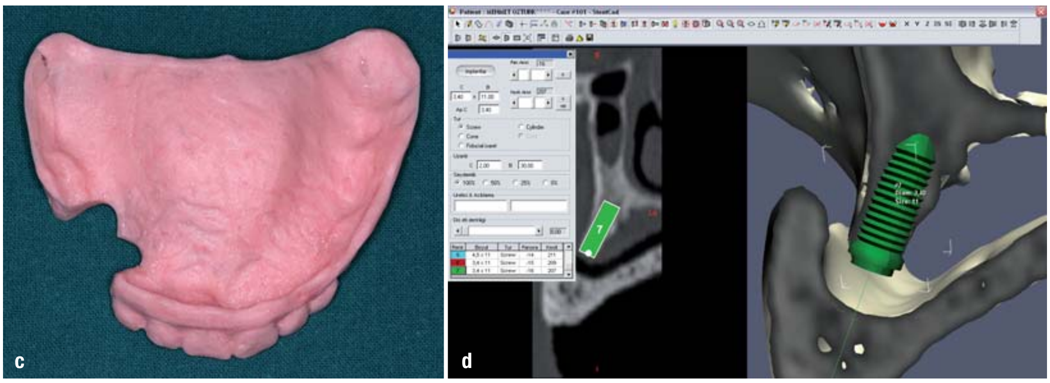
Fig. 2_ (a) Intraoral view of the maxilla, **(b)** duplication of the current prosthesis and preperation of the scan prosthesis with Br_2S_4,**(c)** scan prosthesis, **(d)** planning phase.



during surgery. The guide is adapted on the mucosa in occlusion to the opposing dentition then secured with fixation screws. Following the removal of soft tissue with a punch drill, osteotomy was performed and total number of 72 implants was inserted by this method. Patients were screened following the surgery and a new DVT were obtained at the stage of loading for examining the accuracy of the implant positioning. Postoperative swelling was almost unnoticeable and the pain was reported only for the day of the surgery. All implants except 2 were osseointegrated at the end of 3 months. The method enables clinician to plan and place implants without the need of an exposed flap in selected cases however a large group of cases should be analyzed for the routine use of this guidance.

_Introduction

Conventional implant planning mainly depends on panaromic X-rays. However certain drawbacks are present with panaromic and periapical X-rays such as distortion and two dimension restrictions. The difference in accuracy between different methods has been investigated and documented in a study by Sonick et al. (Table 1). Despite the acceptable mean distortion rate in panaromic and periapical X-rays maximum achieved distortion rates may lead to false proximity or intrusion to vital anatomic structures in rare occasions. Furthermore owing to the lack of anatomic references, visual planning and conventional implant placement is challenging especially in total edentulous cases . This type of a case is likely to end up with implants engaging the approximal regions with undesired emergence profile and screw access hole. As a result the case may be a failure especially in highly demanding patients with high lip line. Surgical guides can be used to overcome this problem to a certain degree however the exact 3-D positioning is unfortunately impossible with guides based on radiologic markers, impressions and intra-oral bone mapping techniques. Following the introduction of the computerized dental tomography, diagnosis and treatment planning can be visualized on three-dimensional (3-D) images. Further development and integration of DICOM data on the specifique dental implant software enabled to construct a 3-D view of the alveolar bone and place implants in real dimension accuracy. By the introduction of volumetric tomography, dose concerns with conventional CT imaging were not an issue of concern. Because the dose with a DVT is equal or slightly higher than a conventional panaromic radiograph. The surgery can be virtually performed on the computer using realistic implant fixtures. In case of having a scan prosthesis the ideal implant position can be assigned in relation to bone height, width, angulation and emergence profile. Necessity of angled abutment and possible screw access points can also be planned in advance the fabrication of the final prosthesis . Stereolitography is a relatively new advancing technology in the dental field. Engineering part of this technology is still in demand of dental view and opinion. Most systems can only offer direction guidance with the surgical guides, however few of them offer depth control but only when certain brands of implants were used. The technique is time



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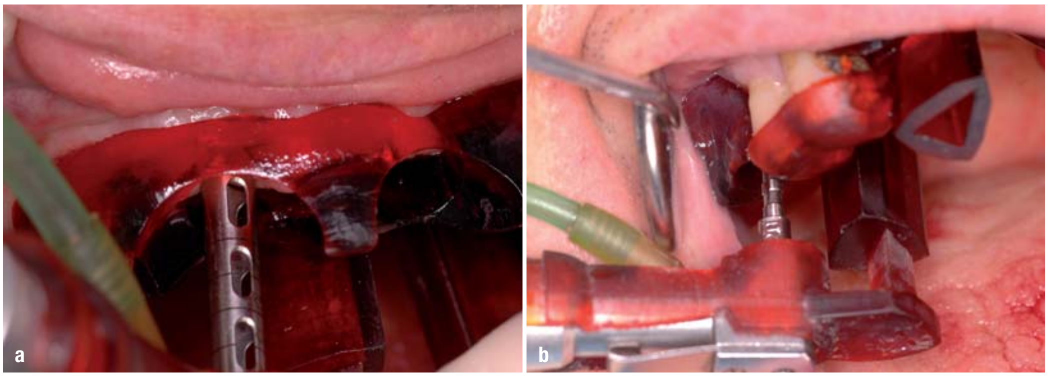

Fig. 3_ (a) Mucotomy was perfromed with a punch drill, **(b)** Original drills of the implant system were used for osteotomy.

consuming and costly at the moment and deviation rates is still an issue of concern. A new surgical guide (Ötede, Aytarasrim, Ankara, Turkey) is currently investigated in Istanbul University, Faculty of Dentistry, Department of Oral Implantology (Fig. 1). The main idea is to shift the guidance from drill to handpiece. A male-female triangular lock mechanism is placed to the guide. This enabled to drive the handpiece in the exact route and depth without drill dependency as seen in other systems like SimPlant, Aytasarim3D etc. The new system requires individual stereolitographic key for the handpiece to be used in the surgery (Fig. 2). The handpiece and drills were scanned before surgery to simulate depth control and drill guidance with the handpiece.

_Material and methods

Following the anamnesis, clinical and oral examinations were performed for 5 patients with various edentoulism types. The patients were informed about the flapless option with guided surgery and written consent was taken. Patient's current prosthesis was evaluated for the fit and positional accuracy. This prosthesis was duplicated in clinic with the negative impression technique. Cold polymerising acrylic was prepared with 10 per cent barium sulphate addition and mixed well then poured carefully into the drainage holes of the duplication mold. Following the setting, the mold was opened and the scan prosthesis is removed and trimmed and polished. The prosthesis is tried to ensure that the patient can wear it comfortably during tomographic scan. Any disturbing pieces or edges may lead patient to mis-position the prosthesis during scan causing error in the CT images (Fig. 2). The DICOM data is transferred to a personal computer. A 3-D implant image processing software (Implant3D, MediaLab, LaSpezia, Italy) was used to plan implants. Following the segmentation of the bone and prosthesis the implant placement is performed on the computer with guidance of the scan prosthesis.

Following the planning, the manufacturing of the surgical guide began. The system requires the scan of the handpiece head region. Drills to be used in the osteotomy were also required to be scanned for correct depth control. All components were tried before surgery to ensure the proper operation of the triangular lock mechanism.

Surgery: The guide was tried once again for the accuracy of fit. Local anesthesia was administered with infiltration. Following the stabilization of the guide with fixation screws, handpiece lock was adapted to the handpiece. Mucotomy was performed with a punch drill. Routine osteotomy protocol was used using the triangular lock in the surgical guide. Depth control was also provided with the stop of the triangular lock. Following the insertion of the implants the guide was removed from the mouth and gingival formers are placed (Fig. 3). A total of 72 implants were placed in maxilla and mandible.

Postoperative follow-up: All patients were recalled after the surgery day and controlled everyday for a week. Then all patients were examined with one month intervals.

Results: Two implants in a patient were lost in the post-op second week. Rests of the implants were osseointegrated at the end of healing period. No complications were observed during the healing period. Swelling was minimal due to the flapless surgery. Pain complication was also recorded to be minimal and mainly experienced in the day of surgery.

_Discussion

As a result of the advances in fast prototyping and 3-D printing field, many stereolitography based surgical guide systems became available on the market for providing accurate positioning of dental implants. The procedure can be outlined as a 3-D engineering and many variations are present amongst systems. As a result the benefits vary depending on the design of the guide. All systems provide horizontal guidance but depth control is provided only in few systems intended for a specifique implant system. The present surgical guide may use any type of implant drill after it has scanned. The top of the female lock mechanism attached on the surgical guide serves as a stopper for providing depth control. Drill guidance is the main base of direction in static surgical guides. To maintain the directional accuracy, most system provides se-

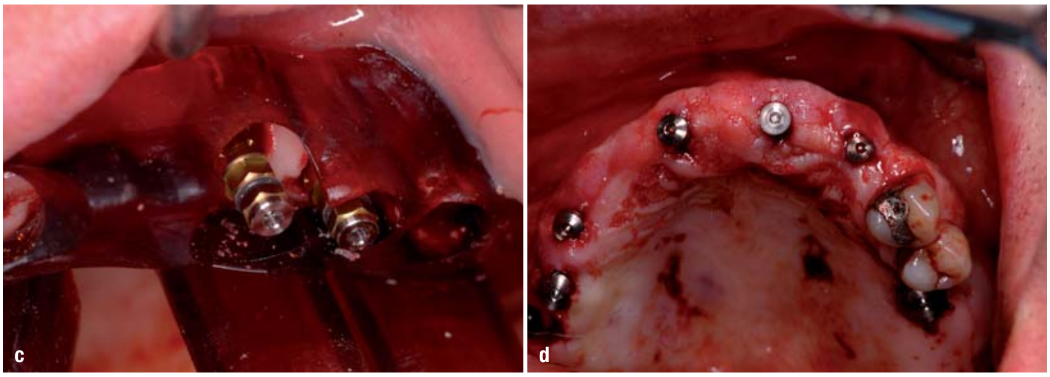

Fig. 3_ (c) Implants were inserted, (d) clinical view following the placement of the gingival formers.

quentially increasing diameter drill tubes either fixed or changeable. Inclusion of multiple numbers of drill guides during the surgery increases the surgical time, risk of deviation and complexity of the surgery. Some systems overcome the problem of multiple guides by using changeable tubes. However small tubes can be difficult to mount and remove in the oral environment. These small tubes bring the risk of inhalation, loss, stuck in place etc. Use of a single guide in this study significantly decreased the surgical time and relevant complications. Furthermore drill guidance requires the inclusion of metal tubes for the drill to be thoroughly operated. This may significantly reduce the irrigation and arise the risk of overheating in the osteotomy site owing to the friction and restricted liquid flow way through the metal tubes. The system used in this study does not contain any metal tubes in the drill pathway and has wide holes in the field of osteotomy allowing higher level of irrigation liquid to cool the osteotomy site. It should be always kept in mind that the risk of overheating can be a cause of failure in surgical guide systems and flapless surgery. The drill rpm should be below 750 rpm with maximum possible irrigation. Drill independency makes this system virtually suitable for any implant system which may be an advantage when compared to drill and implant system based guides.

_Conclusion

The new surgical guide in this study has promising features and advantages compared to similar stereolitographic surgical guide systems. Handpiece orientation adds additional comfort and freedom for the surgeon. Further analytic studies are required to evaluate the positional accuracy and additional benefits of this system._

References

Sonick B. Int J Oral Max Implants, 1994;(9)455–460.

Poppe B, Looe HK, Pfaffenberger A, Chofor N, Eenboom F, Sering M, Rühmann A, Poplawski A, Willborn K. Dose-area product measurements in panoramic dental radiology. Radiat Prot Dosimetry. 2007;123(1):131–4. Epub 2006 Aug 12.

Martegani P, Silvestri M, Mascarello F, Scipioni T, Ghezzi C, Rota C, Cattaneo V. Morphometric study of the interproximal unit in the esthetic region to correlate anatomic variables affecting the aspect of soft tissue embrasure space. J Periodontol. 2007 Dec;78(12):2260–5.

Buser D, Martin W, Belser UC. Optimizing esthetics for implant restorations in the anterior maxilla: anatomic and surgical considerations. Int J Oral Maxillofac Implants. 2004;19 Suppl:43–61.

Nickenig HJ, Eitner S. Reliability of implant placement after virtual planning of implant positions using cone beam CT data and surgical (guide) templates. J Craniomaxillofac Surg. 2007 Jun–Jul;35 (4–5):207–11. Epub 2007 Jun 18.

Widmann G, Widmann R, Widmann E, Jaschke W, Bale R. Use of a surgical navigation system for CT-guided template production. Int J Oral Maxillofac Implants. 2007 Jan–Feb;22(1):72–8.

Lascala CA, Panella J, Marques MM. Analysis of the accuracy of linear measurements obtained by cone beam computed tomography (CBCT-NewTom). Dentomaxillofac Radiol. 2004 Sep;33(5):291–4.

Meyer U, Wiesmann HP, Runte C, Fillies T, Meier N, Lueth T, Joos U. Evaluation of accuracy of insertion of dental implants and prosthetic treatment by computer-aided navigation in minipigs. Br J Oral Maxillofac Surg. 2003 Apr;41(2):102–8.

Sherry JS, Sims LO, Balshi SF. A simple technique for immediate placement of definitive engaging custom abutments using computerized tomography and flapless guided surgery. Quintessence Int. 2007 Oct;38(9):755–62.

Sarment DP, Al-Shammari K, Kazor CE. Stereolithographic surgical templates for placement of dental implants in complex cases. Int J Periodontics Restorative Dent. 2003 Jun;23(3):287–95.

Tardieu PB, Vrielinck L, Escolano E, Henne M, Tardieu AL. Computer-assisted implant placement: scan template, simplant, surgiguide, and SAFE system. Int J Periodontics Restorative Dent. 2007 Apr;27(2):141–9.

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