CASE REPORT

Guided Implant surgery and Immediate Function: An Emerging Trend in Full Arch Rehabilitation of Edentulous Patients

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Journal of Dentistry Defence Section 2016; 11.1, 44-50

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Abstract

Implant dentistry is in the midst of a revolutionary change in providing an effective and predictable approach to provide full arch immediate fixed teeth for edentulous patients using CT/CBCT imaging and CAD/CAM technology. This article reviews the rationale, techniques, and advantages of a guided full-arch immediate function implant treatment modality that includes placement of prefabricated conventional denture using conversion technique for edentulous patients. The case presentation depictsa protocol highlighting on the surgical and prosthetic sequence, laboratory techniques, materials, and occlusal management of both the provisional and final prostheses.

Keywords: *'All-on-4' concept, 3D Virtual implant planning software, CAD/CAM, CT/CBCT Guided Implant surgery, Immediate function.*

Introduction

For patients with complete edentulism, it would be a great clinical advantage to restore function and aesthetics in the same session with a minimally invasive flapless surgical approach, and immediate placement of a provisional prosthesis, thereby significantly reducing morbidity, treatment time and costs. Immediate loading can be a viable solution in cases of full edentulism and several studies have demonstrated that immediately loaded full arch fixed prostheses represent a valid treatment option with a high survival rate of both implants and prostheses in maxilla and mandible[1,2].

Different protocols have been developed for the immediate rehabilitation of edentulous jaws. One of these is the *'All-on-4'* concept[3-5]. This concept implies the placement of four strategically positioned implants, two mesially and two distally placed and tilted. By using this procedure, bone augmentation procedures may be avoided in cases with reduced residual bone volumes. As in any other immediate function application when sufficient primary stability is achieved, the probability of a successful treatment outcome is high.

The major excitement and buzz in the field of implant dentistry in recent years involves the introduction of three-dimensional virtual evaluations of patients using CT or in-office cone beam (CBCT) scanners[6]. Nowadays, advancements in computer science and technology allow a combination of the conventional *'All-on-4'* treatment protocol with 3D software planning after CT/CBCT examination, guided minimally invasive surgery, and immediate provisional prosthesis delivery[4-5].

The bone available for implant placement, soft tissue thicknesses, location of the maxillary sinuses, and pertinent vital structures such as the mandibular canal can all be visualized. These technologies can be utilized for three-dimensional diagnoses, virtual treatment planning, and designing surgical guides that allow the surgeon to duplicate a virtual treatment plan at the time of surgery. A customized surgical template allows transfer of the planned implant position, and prefabricated acrylic resin prosthesis is made. Treatment time and post-surgical discomfort are reduced since implants can be placed without elevating a flap and a provisional prosthesis can be delivered in the same session[7-10]. This process results in more accurate and predictable implant placement and reduces patient morbidity[11].

Virtual treatment planning and computer generated drilling guides benefit the patient by allowing flapless surgery, reducing surgical time, reducing discomfort and swelling, and allowing a quicker return to their lives and work. It benefits the clinician by reducing chair time, reducing stress at the time of surgery, facilitating an accurate means of placing dental implants, and reducing potential surgical complications. Potential implant positioning mistakes are alleviated by first making them on the computer. The treatment planning process starts with visualizing the final prosthetic result and precisely working backwards from there. The positions of the planned restorations, as they relate to the underlying bone, are determined prior to surgery. Most importantly, this technology allows the surgeon and restorative dentist to plan the treatment and place implants according to a prosthetically-driven treatment plan.

Case Report

This guided full-arch immediate-function treatment modality is well demonstrated with the following patient. A 60-year-old man presented with a maxillary and mandibular complete dentures that he had worn for 05 years. He was dissatisfied with his dentures and expressed strong interest in having fixed teeth.

A thorough clinical and CBCT sequential digital diagnostic radiographic evaluation revealed moderately atrophied edentulous maxillary and mandibular arches. The clinical evaluation included information regarding lip length and support, existing tooth position within the denture, occlusion, restorative space, and phonetics. It also revealed adequate restorative space present to avoid bone reduction and to allow for a flapless approach to the maxilla, while the mandible would be treated with full flap reflection and alveolectomy. A graftless solution was then presented to the patient that included full-arch immediate teeth in both the maxilla and mandible, all delivered via a fully guided immediate-function approach at one appointment that would include placement of conversion type maxillary and mandibular fixed provisional prostheses.

The patient was scheduled for diagnostic records that included clinical digital photographs, bite registration, along with CBCT scans with maxillary and mandibular dentures with radiographic markers in-situ and the bite registration in place. The maxillary and mandibular dentures were then scanned separately as per the dual-scan protocol. The dentures were deemed appropriate in terms of esthetics, phonetics, tooth position, and vertical dimension of occlusion (VDO), to provide stability for accurate recording. The DICOM data sets were then uploaded to web-based software AB Denpax viewer version 3.3 (AB Dental Devices, Ashdod, Israel) with a digital form.

In the computer lab the patient's digital 3-D data set was then merged with the underlying 3-D bone structures taken from the CBCT scan relative to each other, forming a complete 3-D patient-specific data set using AB Guided Service Software (AB Dental Devices, Ashdod, Israel). Using the software, the clinician reviewed the relationships of the planned prosthesis to the patient's three dimensional bony architecture and associated anatomical structures. Implants and abutments were virtually placed on the computer screen (Fig 1). A prosthetically-driven treatment plan was created by placing the implants in an ideal relationship to the planned dental restorations and the associated supporting bone. The treatment plan was so formulated that it included optimal implant size, location, and angulation with overlying prosthetic components. The virtual treatment plan was then electronically transferred to the manufacturer for the production of a stereolithographic surgical drilling guide (Fig 2).

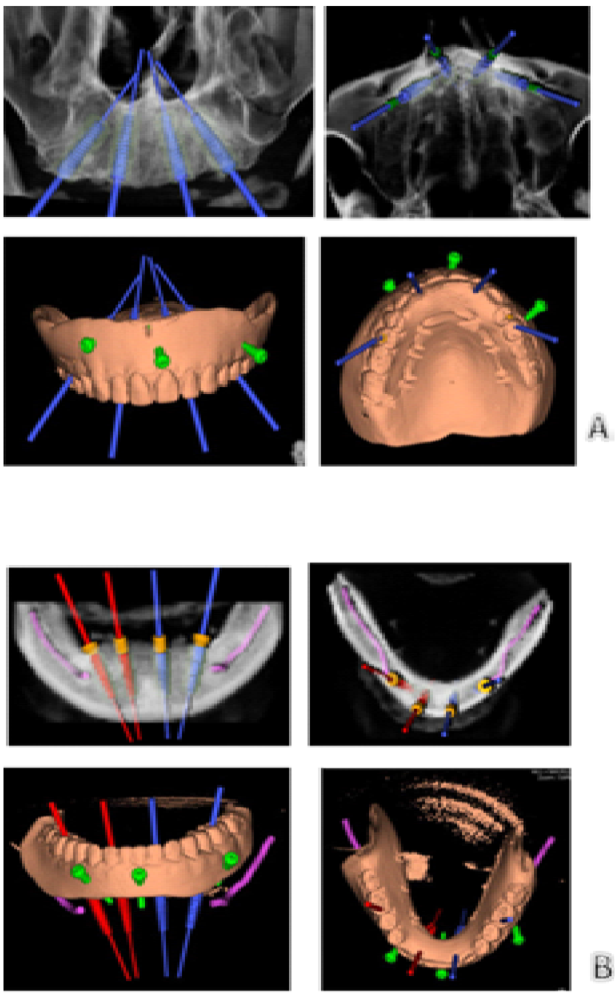

Fig 1: A. Virtual maxillary treatment plan; B.Virtual mandibular treatment plan with two mesial axially and two distal tilted implants using AB Guided Service Software (AB Dental Devices, Ashdod, Israel).

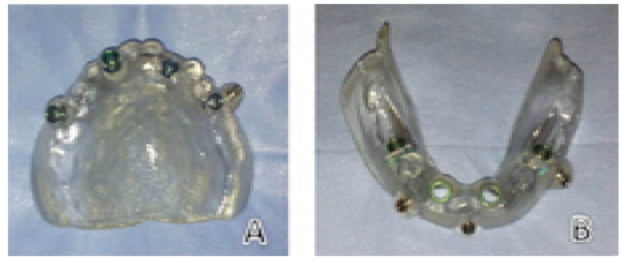

Fig 2: 3D-printed maxillary (A) & mandibular (B) surgical guides with metallic sleeves for implant surgery on occlusal aspect and pin fixation on buccal flange. The surgical guide is a digital copy of the denture and fits exactly like the denture.

A flapless approach with four implants each was planned for the maxillary and mandibular arches. The patient was seen for final case presentation, informed consent, prescriptions, and scheduling the date of surgery. The next appointment was for the planned surgery. The patient was operated under local anesthesia administered in both arches. The mandible was treated first followed by maxilla.

A surgical guide was placed over the edentulous mandibular arch and secured with three fixation pins while using a bite registration against the opposing maxillary complete denture to verify its appropriate 3-D position. A fully guided flapless protocol was used with the appropriate drilling sequence using AB Guided Drill kit (AB Dental Devices, Ashdod, Israel) to place four endosseous (I55™ implants, AB Dental Devices, Ashdod, Israel), one each in the following sites: right second bicuspid, right lateral incisor, left lateral incisor, and left second bicuspid.

All implants were placed with insertion torque values varying from 35 Ncm to 45 Ncm (Fig 3). The surgical guide and implant mounts were then removed and the preselected multi-unit abutments were placed and torqued into position according to manufacturer's recommendation. Periapical radiographs were used to verify full seating of all abutments. Pre-cut temporary cylinders were then placed into the multi-unit abutments, and after access-hole block out, the patient's existing dentures were positioned over the cylinders. Next, a bite index was used to verify accurate positioning of the bridge. The prosthesis was then luted to the temporary abutments by injection of flowable composite via previously drilled access holes (Fig 4). The prosthesis was unscrewed, cleaned, and contoured with acrylic out of the mouth. A similar protocol was also used for maxillary arch.

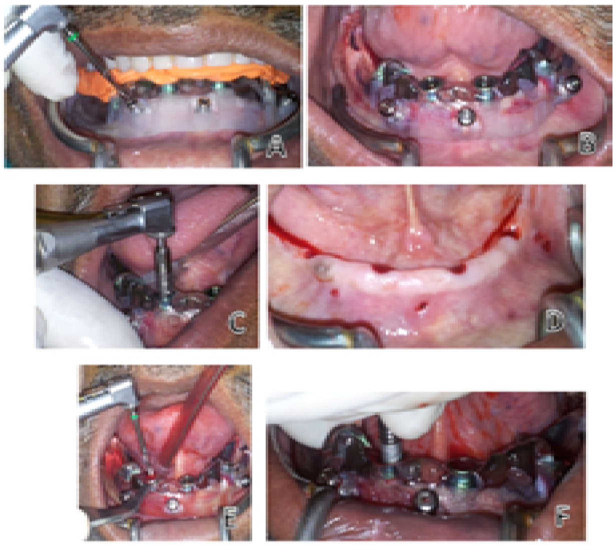

Fig 3: Guided Surgery Protocol for mandibular arch

A. The mandibular surgical guide is oriented and stabilized with the help of maxillary denture and fixation pin is engaged.

B. The contact with the soft tissue can be seen through the transparent guide.

C. Tissue punching through the guide. The punched tissue is teased out after the removal of guide.

D. After the tissue is removed, and the surgical guide is returned for drilling and implant placement.

E. Drilling through the surgical guide. The drill tool changes the sleeve diameter for each drill.

F. The implant placement as per the plan is done using colour coded implant mount.

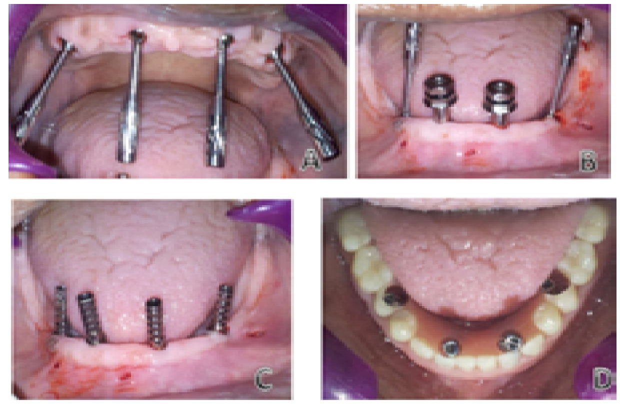

Fig 4: Conversion Denture Technique for Immediate Loading

A. Multi-unit abutments are screwed on to the maxillary implants and mandibular implants

B. As per the plan to correct angulation issues with axially placed and titled implants.

C. Titanium temporary cylinders placed into the multi-unit abutments.

D. Access-hole cut out of the patient's existing dentures positioned over the cylinders for chairside pick-up to fabricate conversion denture.

Immediate implant placement and provisionalization offer a potential for premature loading, which could prevent osseointegration. The occlusal contacts can be adjusted to the opposing arch and will produce simultaneous bilateral contact and group function in eccentric movements to help spread the occlusal forces evenly across the arch form. Thus maxillary and mandibular bridges were then screwed into place with a slight bite adjustment (Fig 5).

The patient then returned for follow-up visits at 48 hours, 1 week, 2 weeks, 1 month, 3 months and 06 months for bite adjustment and supportive care prior to fabrication of the final prostheses. The final restorative phase of treatment was initiated after 6 months of healing and stabilization of hard and soft tissues. The procedural steps within the protocol were designed to minimize the time and number of appointments and maximize the accuracy produced in the provisional restorations.

Three appointments were necessary to allow for seating of the final prostheses, which consisted of a maxillary and mandibular full-arch cast metal-acrylic screw-retained bridge (Fig 6).

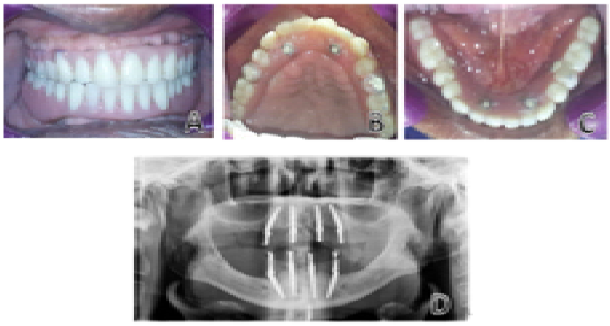

Fig 5: Immediate Post-op View
A. Immediately loaded screw-retained fixed hybrid conversion dentures.
B. Maxillary hybrid denture.
C. Mandibular hybrid denture.
D. Panoramic view

Fig 6: Post-operative view.
A. Finished maxillary & mandibular metal-acrylic maxillary and mandibular fixed hybrid dentures
B, C, D. Intral-oral view
E. Post-op Panoramic view
F: Extra oral view

Discussion

Inherent in digital technologies for full-arch guided implant surgery and immediate fixed prosthetic rehabilitation is the need for each of the multiple disciplines involved to participate in the collaborative goal of an optimized reverse-engineered implant and prosthetic treatment plan. Diagnostic CBCT imaging, intraoral and extraoral optical imaging systems, 3-D CBCT interactive implant planning software, implant surgical guides, implant systems and prosthetic abutments, and CAD/CAM laboratory manufacturing technology all are making advances that potentiate improved case results.

Two-dimensional (2-D) diagnosis with freehand surgical application and conversion of an immediate denture are the hallmarks of the "All-on-4" approach as presented by various authors. Inherent in this system are the inaccuracies of 2-D radiographic diagnosis and planning, prosthetic compromise and complications, and clinical success directly proportional to operator skill, experience, and technique variables.The ability to accurately and predictably pre-plan the implant positions relative to the ideal prosthesis has preemptive advantages over the status quo reactive freehand conversion of a non-reinforced immediate denture. One notable benefit of this guided protocol could arguably be for the patient as well as the dentist[12]. In addition, patients leave the surgical experience with the confidence.

The freehand implant surgical technique currently employed in dentistry does have an advantage in patients with poor bone quality, because multiple implant osteotomies can be drilled into alternate implant sites until the desired torque has been attained to support an immediate fixed hybrid that will be custom fitted to various implant levels and abutment trajectories. One could also argue that the freehand technique has the advantage of allowing for better tactile proprioception for bone "feel" during the drilling and hand insertion sequence and implant placement. With fully guided protocols, the implants are placed through the master tubes by a "guided implant mount" that has tight tolerances to mate with the inner diameter of the master tube in the acrylic surgical guide, decreasing feel for the bone quality and density.

Nevertheless, as dentists learn how to interpret the virtual DICOM data on bone quality, density, and volume as it relates to the actual biological bone quality, density, andvolume, that knowledge will be applied to consistently achieve predictable initial torque and implant stability, ultimately resulting in the confidence to trust the fully guided surgical planning and implant placement.

Implant dentists striving for consistent clinical excellence in guided implant surgery and immediate full-arch fixed prostheses face a myriad of challenges, the most difficult of which arethe integration and coordination of these multiple technologies and definitive communication of the clinical and virtual variables inherent in 3-D digital implant and prosthetic software planning. New dental laboratory technologies, communication with dental laboratories, and an inherent lack of experience in full-arch cases among all parties can further compromise excellence.

Compared with a freehand 2-D approach, the precision, predictability, and consistency of this fully guided surgical and immediate fixed prosthetic method presents such clinical advantages as: 3-D-precision digital implant planning and virtual surgical and prosthetic work-up; optimized interdisciplinary treatment planning and communication; maximization of All-on-4 engineering, implant lengths, diameter, and angulation, and available bone; objective clinical control of 3-D occlusal variables; fewer patient appointments and less chairtime; and excellent professional/medicolegal documentation.

Conclusion

Clinical perfection in dental practice is the result of a sequence of simple repetitive steps performed precisely and sequentially in every patient case. As such, the goal for any new technological and procedural integration in clinical dental implant practice should be to reduce multiple therapeutic modalities to a series of precise reproducible steps that ensure consistency and predictability of the patient's surgical and prosthetic treatment plan.

This guided protocol is the practical manifestation of this goal, resulting in a seamless integration of multiple digital diagnostic, surgical, prosthetic, and laboratory modalities to achieve a predictable and consistent reverse-engineered fully guided surgery and immediate full-arch fixed prosthetic result. Patient selection, accurate records, and detailed virtual planning are of paramount importance in utilizing this system. In total, four essential appointments with the patient are needed from scan to delivery of the final prosthesis: 1) record taking; 2) surgery and provisionalization with conversion denture protocol; 3) wax tryins on bars; and 4) final delivery of the definitive full-arch implant-retained prosthesis.

References

1. Yamada J, Kori H, Tsukiyama Y, Matsushita Y, Kamo M, Koyano K. Immediate laoding of complete-arch fixed prostheses for edentulous maxillae after flapless guided implant placement: a 1-year prospective clinical study. Int J Oral Maxillofac Implants. 2015 Jan-Feb;30(1):184-93.
2. Marchack CB, Moy PK. Computed tomography-based template guided implant placement and immediate loading: an 8-year clinical report. J Prosthet Dent. 2014 Dec;112(6):1319-23.
3. Malo P, de Araujo Nobre M, Lopes A.The use of computer-guided flapless implant surgery and four implants placed in immediate function to support a fixed denture: preliminary results after a mean follow-up period of thirteen months. J Prosthet Dent. 2007 Jun;97(6 Suppl):S26-34.
4. Orentlicher G, Jensen O, Horowitz A, Adams M, Abboud M. Combining All-on-4 treatment with CT-guided technology and report of three cases.CompendContinEduc Dent. 2013 Jul-Aug;34(7):534-44.
5. Pomares C. A retrospective study of edentulous patients rehabilitated according to the 'all-on-four' or the 'all-on-six' immediate function concept using flapless computer-guided implant surgery. Eur J Oral Implantol. 2010 Summer;3(2):155-63.
6. Jacobs R, Quirynen M. Dental cone beam computed tomography: justification for use in planning oral implant placement. Periodontol 2000. 2014 Oct;66(1):203-13.
7. Orentlicher G, Horowitz A, Goldsmith D, Delgado-Ruiz R, Abboud M. Cumulative survival rate of implants placed "fully guided" using CT-guided surgery: a 7-year retrospective study.CompendContinEduc Dent. 2014 Sep;35(8):590-98, 600.

8. Hultin M, Svensson KG, Trulsson M. Clinical advantages of computer-guided implant placement: a systematic review.Clin Oral Implants Res. 2012 Oct;23Suppl 6:124-35.

9. 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 Suppl:25-42.

10. Sicilia A, Botticelli D. Computer-guided implant therapy and soft- and hard-tissue aspects. The Third EAO Consensus Conference 2012.Clin Oral Implants Res. 2012 Oct;23Suppl 6:157-61.

11. Vercruyssen M, Hultin M, Van Assche N, Svensson K, Naert I, Quirynen M. Guided surgery: accuracy and efficacy.Periodontol 2000. 2014 Oct;66(1):228-46.

12. Han JH, Kim KE. Comparison of Expectation and Satisfaction of Implant Patients in Pre-post Implant Therapy. J Dent Hyg Sci. 2011;11:121–127.