

Editorial

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3D Printing in Dental Implantology

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Dental implantology is a traditional approach offered to fully or partially edentulous patients. Successful placing of implants needs specialized skill sets and expertise in order to achieve their viability. 3-D printing along with digital technology have made significant improvements to rate of success and have transformed work process and practices in standards of care in dental implants. Advanced-thinking clinicians and the dental laboratories have harnessed benefits of the digital technology for ensuring best outcomes for the patients as well as providing versatility and savings in time and cost. This paper discusses workflows by which a summarized surgical guide can be obtained.

OVERVIEW

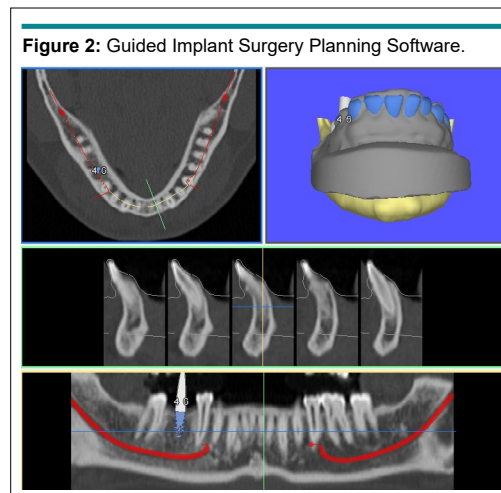
Dental patients look for various options for maintaining long lasting oral health. Implants offer a viable solution for replacing missing teeth with no need to do away with surrounding healthy dentition. By traditional practice, it required patient undergoing set of preparations on adjacent healthy teeth for constructing a bridge. Though this process fulfills the requirement of replacing a tooth, this process has to cut tooth structures of healthy teeth adjacent to missing tooth. Dental implants have removed this requirement and thus are offering a more conservative solution for replacement of missing tooth. The clinician places an implant into site of missing teeth without causing any damage to the adjacent healthy teeth. Placing of the dental implants requires some special considerations taken prior to the process. It is required to ensure that location, size of implant and angulation should be appropriate and also specific to site; the clinician has to take into consideration of biomechanics of bone density, nerves and sinuses of the patient.^{1,2} Conventional surgery was done by hand or the surgical guides were prepared on solid gypsum stone models or used dentures fabricated in laboratory and holes were drilled prior to guide the hand piece of the surgeon. With advancements in digitization and cone beam computed tomography (CBCT) scan, it is now possible to perform truly guided surgery (Figure 1).

Figure 1: Surgical Guide.



GUIDED IMPLANT SURGERY WORKFLOW

Guided implant surgery requires running cone beam scan on patient as a first step as it provides wealth of information about bone, soft tissues, bone density, nerves and location. The digital imaging and communications in medicine (DICOM) file or rendering of the anatomy of the patient is integrated to yield guided surgery software (Figure 2). In this software program clinician and dental technician is able to virtually place the implant and run number of test for ensuring best location outcomes.^{3,4} The impression of the mouth of the patient is captured with analog



PVS method or with a digital intraoral scanner from which model is prepared and scanned.⁵ This generates an optical scan providing a scan to 3D print (STL) file which can be simply and quickly overlaid onto DICOM (cone beam) file and generate a comprehensive STL file for importing in to guided surgery software program. In this guided surgery software, clinician is able to choose type of implant system and size of the implant. The software program automatically creates the implant and enables the clinician to position the implant in bone virtually. After the implant and the location are in line with intraoral scan or with the optically scanned model, they are overlaid and integrated into one open source concise STL file. This file may be now manipulated for designing a surgical guide. Design of the surgical guide in software program presents the clinician with a freedom for achieving optimal results and the best treatment procedures and protocols in order to achieve high standard of care.^{6,7} This procedure makes it easy and fast to plot location and borders of guide. After selecting the plot all affected areas are considered and the software is able to generate a hole virtually where the drill guide sleeve is to be attached.⁸

After the design of implant surgery guide, it is a simple task to export comprehensive STL file to 3D printer for obtaining quickly a seamless surgical guide. The guide gets printed in bio-compatible material for contacting with oral environment for short duration. The material is specifically approved contact with mucosal membrane for short-term period up to 24 hour duration. The hole is to accept either a metal sleeve glued to the guide or pre-designed hole is 3-D printed and used with drill guided sleeve which fits on dental drill and guides clinician to location and depth of the implant placement.^{9,10}

REALIZING BENEFITS

It is possible to broaden the restorative protocol by using the dual scans. These dual scans enable providing additional level of treatment as the patient can be scanned while wearing denture and once again without wearing the denture (this is also achieved digitally). The dual scans offer more information on the guided surgery as now the data about patient's teeth or the necessary future placement of teeth is also included in treatment plan and not only the location and bone considerations.^{9,11}

There are various benefits in using 3D printed surgical guides in the clinical environments. Among its three important benefits, the first one is that of completely customizable control of surgical guide and the treatment protocol. The next important benefit gained by digital dentistry is that it provides a considerably faster treatment protocol and the patient turnaround time. A patient, after coming in can be assessed and just start and complete the treatment in a significantly reduced time period. This advantage elevates the dental experience of the patient and offers a better and faster outcome. Another benefit is that having an in-house 3-D printer for generating the surgical guides offers considerable cost savings.¹²

CONCLUSION

It is the constant endeavor of the dental professionals to seek to improve and enhance the standards of care of their patients; this goal is easier to achieve with the help of 3D printing and digital technology. The professionals who are forward thinking are now using such technological solutions for obtaining diverse treatments and the services for their current and future patients. This technology-driven solution provides business model for the practitioners and the dental laboratories and this model is cost-effective and enhances precision and considerably enhances the dental treatments. And this presents with a better dental experience to the patient and increased viability and longevity of implant based restoration.

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