3-Dimensional printing in dentistry -A review

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Abstract
Advancenced technology in dentistry has helped a lot in the treating the diseases properly. 3D Printing allows the dentist to visualise, record hard and soft tissue significantly with precise measurement and print the models. Use of the CAD/CAM is most advanced one in the dentistry. But it also lack the trainee who knows how to use it. In this article we will show how its is used in various dental treatments.

Keywords: CAD/CAM, CBCT, Stereolithography, 3D printing.

Introduction
3D printing is emerging as a good technology in a variety of areas including arts, design, architecture, engineering, medicine and dentistry. CAD / CAM technology brings 3D printing in medicine and dentistry to revolutionary growth and provides an excellent view for various anomalies.[1] 3D printing gives medicine based on the anatomic data that radiologists acquire and interpret everyday.[2] 3D printing is used mostly to create natural image of the calcified and non calcified structures that it can be seen as such it is in its normal vicinity position. Hull invented 3D printing which he named stereolithography. Stereolithography interprets the data in a CAD file by using the file.[3]

In dentistry, using CT and CBCT data, and also using intra-oral or laboratory optical surface scan data. Advancement in the computer technology and the software applications has contributed a lot to 3D printing. The 3D printing process begins with the design of a virtual image of the object to be created, and then converts the information into a digital file. A 3D modeling program provides the virtual design that the printer should follow. This requires CAD software that can be used to create objects from scratch.[4]

In oral surgery
Using 3d print the perfect anatomical models can be obtained which is used for new treatment and planning purpose as it allows the surgeon to get an overview of the complex structures before performing a surgery on patient.[5] When reconstructing jaw and facial defects, in addition to maintaining uniformity and anatomical appearance, it is also important to restore tissue function. Autologous bone grafts remain the standard for the reconstruction of jaw and facial defects due to their osteoconductive and osteoinductive properties. The main disadvantage of autologous bone grafting is that it is necessary to manually model the shape of the defect. Therefore, a less invasive treatment is needed to treat bone defects. Computer-assisted modeling and rapid production require a series of events that converts a computer-designed virtual three-dimensional image into a solid model for clinical use.[6] It is also used to customised reconstruction plates and morphological reconstruction of bony defect area for cases of fractures.[7]

Fig. 1: 3d image of fracture of mandible

In orthodontics

Invisalign system digitally realigns the patient's teeth to create a series of 3D printed models to build aligners. The patient receives a new set of aligners every two weeks and repositions the teeth for a period of time. This technology saves time, the patient's record can be stored digitally, printed on demand and minimized physical memory requirements. With CAD / CAM technology, two separate bracketing and fork positioning processes merge into one unit. With this method, the need for maximum individuality with a reduced volume is put into practice.[8]

Fig. 2: Aligners built from CAD/CAM technology

In restorative dentistry

Since photopolymerization has long been used in dentistry, 3D printing approaches based on UV or visible light. Therefore, resins are commonly used in 3D printing, but have shown some contraction due to their light-activated and mechanical polymerization properties. Therefore, 3D technology is used.[9] While fabricating restrorations, customary CAD/CAM processing frameworks give various focal points to clinicians and patients, including accuracy. Be that as it may, there are additionally hindrances to subtractive generation strategies. Milling the restoration from a ceramic block, for example, wastes some of the raw material. In addition, exposure to tooling during production presents the possibility of microscopic cracks in the ceramic surface. These shortcomings could be minimized or even eliminated with 3D printing.

In maxilofacial prosthesis

3D printed implants are used to replace and reconstruct the zygomatic bone, the temporal bone, including the auditory ossicles, the calvaria and the jaw. They are also used in the restoration of soft tissues of the head and neck. They are used appropriately after trauma or tumor resection of the ameloblastoma, extensive restoration of bone and soft tissue is required. 3D implants significantly reduced cosmetic defects associated with these surgeries.[10] In implantology, 3D printing and CAD/CAM are additionally picking up acknowledgment for making surgical templates.[11] As per Fuster-Torres et al, the utilization of a CAD/CAM framework, alongside stereolithographic quick prototyping, produces a careful layout that permits increasingly exact arrangement and direction of implants. In 2014, Vidal and Vidal portrayed a technique that uses advanced scanners, 3D printing and CBCT to permit embed arranging in a total computerized convention. The technique includes taking intraoral and extraoral pictures so as to assess the esthetic necessities. The smile line, tooth position and gingival edges are assessed and checked digitally. Study models are examined with a 3D scanner, making a virtual computerized wax up. This enables clinicians to decide the ideal embed position. Next, a tomographic embed control is delivered utilizing CAD programming and 3D printing. The guide is along these lines situated while CBCT pictures are gotten and used in a virtual medical procedure to decide last embed arrangement and position.[11] The actual surgical guide is modeled and printed when the CBCT image of the tomographic guide and digital wax up are integrated and confirmed as a viable placement plan. The study showed that the implants were accurately placed, as per the presurgical implant planning conducted through the combined use of CBCT, scanning and 3D printing. The implant sites showed proper healing and were later restored appropriately. This combined use of technological advances was shown to be more precise than conventional methods of manual wax up and fabrication of surgical templates.[11]

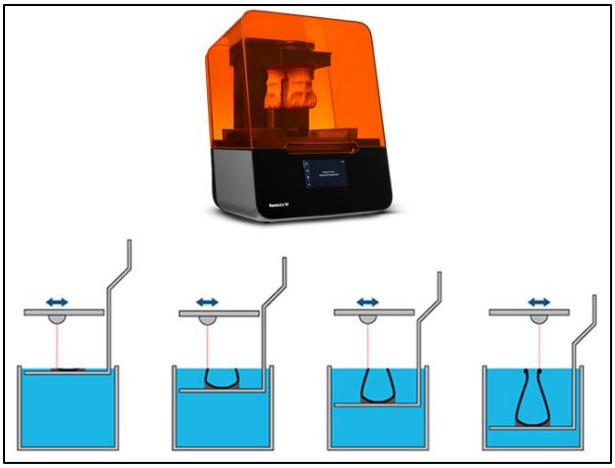

Fig. 4: Stereolithiography

In periodontology

3D printed guides are all the more ordinarily utilized in periodontology for esthetic gingival reconstruction. Persistent explicit careful guides are used for gingivectomy and smile planning.[12] The utilization of 3D printing innovation in Regenerative periodontology is still under research. Studies are being done to assess the utilization of 3D printed biphasic platforms to help in tissue recovery of defects and in healing process.[13] This procedure is called as added substance biomanufacturing. A CT scan of the defect helps in creation of a wax mold from which is intended to make a scafofold that will help in guided tissue recovery.[14]

Fig. 5: CBCT of periodontitis

In endodontics

Endodontics also profits by 3D technology in the creation of exact aides for application in surgical as well as nonsurgical endodontic systems. 3D printed carefully help in a guided apicoectomy. Aides in nonsurgical endodontic methods are particularly useful for get to cavity planning in instances of calcified canals.[15,16] Utilization of 3D printing empowers production of tooth models with sensible anatomical root channel structures by utilizing CT image in this way giving dental students a chance to manage properly, rather than to use of typhodont teeth.

Fig. 6: Surgical splint

Conclusion

With the advent of the 3d printing in dentistry tht is the use of CAD/CAM technology has a huge impact on treatment of patients. It enables to create a geometrical form using a variety of materials from digital data in patients. With the increased use of intra-oral scanning system, in practically in orthodontics by high resolution printing resin, printing models for restorative dentistry and lost wax process pattern. Even though 3D printing is becoming cost effective in the present but still the cost of running, materials used and maintenance of the machines are still of great problem. There is also lack of well trained personnel also causes lack of the use of 3D printing.

Source of Funding

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Conflict of Interest

None.

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