

3D Printing in Dentistry

Khan A.¹, Ahmed R.²

1. **Dr. Atiquzzaman Khan**, Associate Professor & Head, Dept. of Conservative Dentistry & Endodontics, University Dental College & Hospital.

2. **Dr. Rubaba Ahmed**, Associate Professor, Dept. of Science of Dental Materials, University Dental College & Hospital.

The technological revolution has brought changes in every industry, in all aspects of our lives making out life better, easier and comfortable. Dentistry is also not an exception. Numerous technical advancements have shaped the transformation of the dental industry and among them 3D printing technology has a great impact. 3d printing is a form of manufacturing technology which is also known as additive manufacturing, this process gives life to computer aided designs. It involves building objects layer by layer using various materials such as plastic, metal or ceramics. The advent of 3D printing technology has reformed the manufacturing industry by giving form to immensely creative intricate designs which is next to impossible otherwise.

Applications of 3D printing in dentistry:

- **Medical Modelling:** Medical modelling is one the earliest applications of 3D printing in dental industry. Computed tomography data or CT became more and more available in the past century. This availability to CT data led to production of volumetric image data which could then be send to a 3D printing machine in order to make detailed replica of patient's jaws before surgery. This added to new dimension to surgical treatment as the process made it easier for the dentists to analyze any uncommon, unusual or complex feature in the patient's anatomy. This phenomenon also led to the production of different types of drilling and cutting machines using 3D printing technology which was more suitable to the patient's condition.
- **Crown Copies and Partial Denture Framework:** Partial denture frameworks which were previously extremely time consuming to build has become an easy feat with the help of 3D printing technology. With the help of laboratory scanners or high end scanning mechanism it is possible to take image and develop precise computer based model of the tooth to be operated on or the implant to be made. The scanned data and CAD design can be used to print crown or bridge copings, implants and bridge structures. Use of this technology gives more precise result than the existing technology.
- **Digital Orthodontics:** Orthodontics can be more precise and hassle free with the use of 3D printing technology. The intra oral or laboratory scanning provides with an opportunity to take precise image of patient's jaw and plot them in CAD software virtually. Thus model can be used to make aligners with specific designs suited for a particular patient. An example of 3D printing in orthodontics is the use of indirect bracket bonding splints, printed in rigid and flexible materials for precise bracket placement. This data can be digitally saved for further use in the future for further modelling and printing.
- **Light Curing:** Light curing is a very common type of 3D printing technology which uses photosensitive resin materials that are cured and moulded directly under light irradiation. Light curing consists of three main technologies which are SLA, Digital light processing (DLP) and Photo Jet (PJ). SLA consists of a reservoir for the material supplier of photosensitive liquid resin, a model building platform and an ultraviolet (UV) laser to cure the resin. The DLP technology consists of some rectangular arrangements of mirrors which is also called a micro-reflector device. Each mirror is represented by a pixel and the numbers of pixels are the number of mirrors in the device. The principle of PJ is a little bit different than the other two as it uses photopolymerizable inkjet. Here printing process is done using the photopolymer.
- **Fused deposition Modelling:** Fused deposition modelling is one of the most widely used and popular 3D printing

technologies in dental industry. The reason behind its popularity is this process is comparatively cheaper than the other processes. In this process a filamentous thermoplastic material is heated and melted by the nozzle. This nozzle is controlled by the computer aided software and according to the design given to the software the nozzle is moved to print the precise model. This nozzle is movable in X and Y axis direction and the material in the molten state is extruded and finally solidified as it forms layer by layer to give shape to the product. Some of the thermoplastics used in FDM are polylactic acid, polycarbonate and polyamide and among these polylactic acid is the most environment friendly.

In the field of dentistry there is no limit to exploration with 3D printing technologies. It is always possible to create and develop newer and easier methods of treatment with the rising use of technology. The most common applications are the working models for surgery and diagnosis which helps dentists to provide a sound diagnosis and perform better surgery with highest precision. The application of 3D printing technology and CAD/CAM based software on 3D image modelling can produce complex and precise models. The applications will achieve bright future in the field of dentistry.

Address of Correspondence

Dr. Atiquzzaman Khan

Associate Professor & Head, Dept. of Conservative Dentistry & Endodontics

Editor, Journal of Dentistry and Allied Science

An official publication of University Dental College

E-mail: journal.editor@udchbd.com