Role of Additive Manufacturing in Medical Field

The medical industry has started to derive the benefits of Additive Manufacturing, but has not yet explored the full potential, says Ravi Patil.

The anatomy models help doctors. Image source Stratasys

Additive manufacturing (AM) is one of the revolutionary technologies of the decade. Industry has adopted this technology at multiple levels with the aim to derive maximum benefits to reduce time and cost along with improved performance. The medical industry has also started to derive the benefits of AM, but has not yet explored the full potential.

Considering Indian medical industry, it has been found that Cancer is now one of the leading causes of catastrophic health spending, distress financing, and increasing expenditure before death in India. Out-of-pocket expenditure (OOPE) is three times higher for private inpatient cancer care in India. Approximately 40% of cancer costs are met through borrowing, sale of assets, and contributions from friends and relatives; these costs exceed 20% of annual per capita household expenditure in 60% of Indian households with a patient with cancer. Cancer mortality in India has doubled from 1990 to 2016. In February 2020, the World Cancer Day report published reveals that one in 10 Indians will develop cancer during their lifetime. This clearly shows the need to have an affordable and fast treatment procedure for the benefit of common man.

Doctors have used 3D printing to create personalised replica models of cancerous parts of the body so as to target tumours more precisely. This involves printing models of tumours and organs based on CT scans of the patients. These plastic models can be filled with liquid, allowing experts see in detail the flow of radiopharmaceuticals. This helps doctors customise dose for each patient. Patient immobilising fixtures required during radiation treatment can be customised to ensure targeted treatment and avoid damage to other organs.

The anatomy models also help doctors and the surgical team to decide and identify the proper approach to conduct the surgery. Being a full scale model it helps them to visualise the complex nature of anatomy, the tools required and the point of insertion to be taken. The models are also used to conduct mock surgery and is very useful to explain the patient about the procedure to be carried out. The models are also used as teaching aid to the medical students without the need of controlled environment.

“Doctors have used 3D printing to create personalised replica models of cancerous parts of the body so as to target tumours more precisely.

Another area of application would be the customised implants. The standard available implants do not provide adequate fit and have to be modified as per the patient requirement. This is usually done when the patient is in the operation room, which leads to longer operating time. The 3D printed model of the patients helps the doctor to modify the implant well before the surgery and also help him plan the angle of drill, type, size and length of screws required. This customised

approach definitely helps the patient in reducing the OT time and the risk of implant failure. The models are also used to identify and form the necessary implants to perfection, before being used in the operation room. The implants are then sterilised for actual usage. 3D printing models also help to correct the deformity of the relevant anatomical part and assist in restoring a normal life. They involve bone splints, cranial helmets, ear replacements, eye replacements, facial reconstruction, etc.

As in any mechanical engineering industry, a guide is used to locate and guide the operator to cut, drill or carry out any operation. Similarly in medical field the surgical guides are printed which help the doctors to use drills or surgical tools in pre-determined manner. The printed guides when sterilised can come in contact with blood and tissue for short duration. Such guides help the doctor to carry out a procedure in a much more systematic manner, thereby minimising the loss of blood, reduce operating time and cost. The end result is better outcome for the patient. Last but not the least, the 3D models can also be used to develop new tools for optimising surgical approach leading to improved patient care. The above applications clearly indicate a reduced procedural time and better patient care, thereby reducing the overall cost and benefiting the patient. Nothing can be better when technology and health care go hand in hand to reduce time and have a cost saving option.

References

https://www.thehindu.com/sci-tech/health/one-in-10-indians-will-develop-cancer-during-their-lifetime-who report/article30734480.ece
https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0193320

Ravi Patil, National Technical Manager – Additive Manufacturing, DesignTech Systems.

DesignTech Systems has risen to become a leading CAD/CAM/CAE, PLM solutions and Additive Manufacturing technologies provider in India employing a staff of more than 750 dedicated team members serving wide variety of industry segments by providing them CAD/CAM/CAE and PLM software and/or services.