

S11 Three-Dimensional Printing Benefits and Assists in Surgical Planning

Objectives

- Explain what three-dimensional printing is.
- Explain how three-dimensional printing benefits surgical planning / outcomes.

What is Three-Dimensional Printing?

- A tangible, constructed diagram consisting of various blood vessels, organs, tumors, lesions or other structures (Wixted et al., 2021)
- Created via previous imaging taken from other modalities (x-ray, MRI CT, ultrasound)
- Made specific and custom to patient anatomy



Figure 1 shows an MIT engineer holding up a 3D printed replica of a patient's heart made with soft and flexible materials. This replica was used to be able to mimic the patient's blood-pumping ability (Chu, 2023).

Thesis Statement

The introduction of 3D printed models of individualized patient anatomy created from various imaging modalities has offered surgeons a better visualization of body anatomy as well as improved surgical planning for better patient outcomes

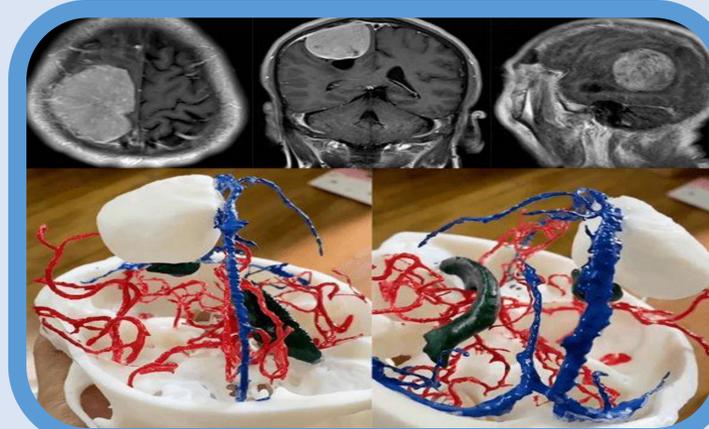


Figure 2 shows a 3D model that was created to view the anatomical structure of the tumor. This allowed surgeons and students to see the relationship between the tumor and arteries, sinuses, and the ventricular system (Create Proto, 2021).

After 3D Printing? Bioprinting

- After 3D printing, a process called Bioprinting can be utilized which uses live cells and tissues to create structures (Wixted et al., 2021).
- This isn't utilized as often because it can be difficult to find a material that will support these live cells (Wixted et al., 2021).
- This future planning could be revolutionary for medicine and save patients' lives (Wixted et al., 2021).

Benefits of Three-Dimensional Printing

- Tangible, handheld model allows surgeons to have more visibility and a better understanding of the anatomical structures (Gillaspie et al., 2016)
- Provides a sense of relief and comfortability for the patient and family members involved (Gillaspie et al., 2016)
- Allows surgeons to perform surgeries more quickly and efficiently, leading to reduced complication rates and a faster recovery time (Gillaspie et al., 2016)

How Three-Dimensional scans are used for surgical procedures

- Improves surgical planning by allowing surgeons to visualize anatomy in its true 3D form before every stepping into an operating room (Li et al., 2022)
- Enables the options of virtual surgeries where procedures can be virtually performed prior to making an incision (Li et al., 2022)
- Increases precision and accuracy allowing for better alignment, symmetry, and outcomes during surgery (Li et al., 2022)
- Reduces risk and uncertainty by identifying challenges and difficulties within anatomy ahead of time (Li et al., 2022)