



Surgical Planning

With Patient-Specific 3D Printed Medical Models





Increased Quality of Care

Personalization is the new norm in healthcare.

Highly accurate recreations of patient anatomy allow surgeons to interact directly with the patient anatomy/pathology prior to entering the OR. This means a better-optimized surgical plan and better-informed patients.

3D printed models allow surgeons to envision complex pathology and spatial and tactile orientations that 2D computer models can't match. Procedures can be refined pre-surgery so there are fewer complications, shorter procedures and faster patient recovery times.

Accurate, realistic medical models help inform patients, enable a strategic surgical plan, reduce procedural cost and ensure an overall better outcome.



Patient understanding of procedure and satisfaction



Multi-disciplinary team communication



Accurate device selection



Reduce radiation exposure

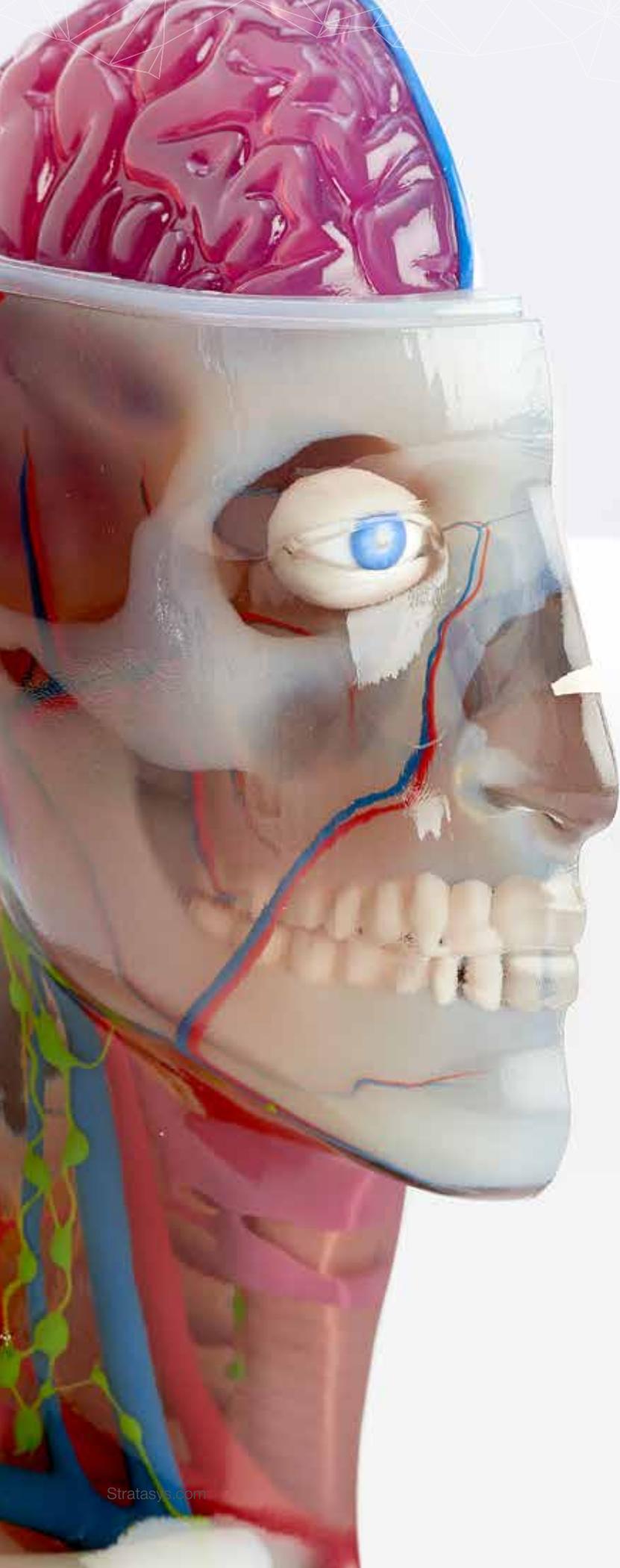


Reduce OR and anesthesia times



Anticipate and avoid complications

OPTIMIZE PROCEDURAL OUTCOMES WHILE DELIVERING COST SAVINGS



Improve Clinical Outcomes

Plan

3D printed medical models optimize a physician's therapeutic approach.

Gain physical, spatial and tactile orientations that 2D computer models can't match.

Practice

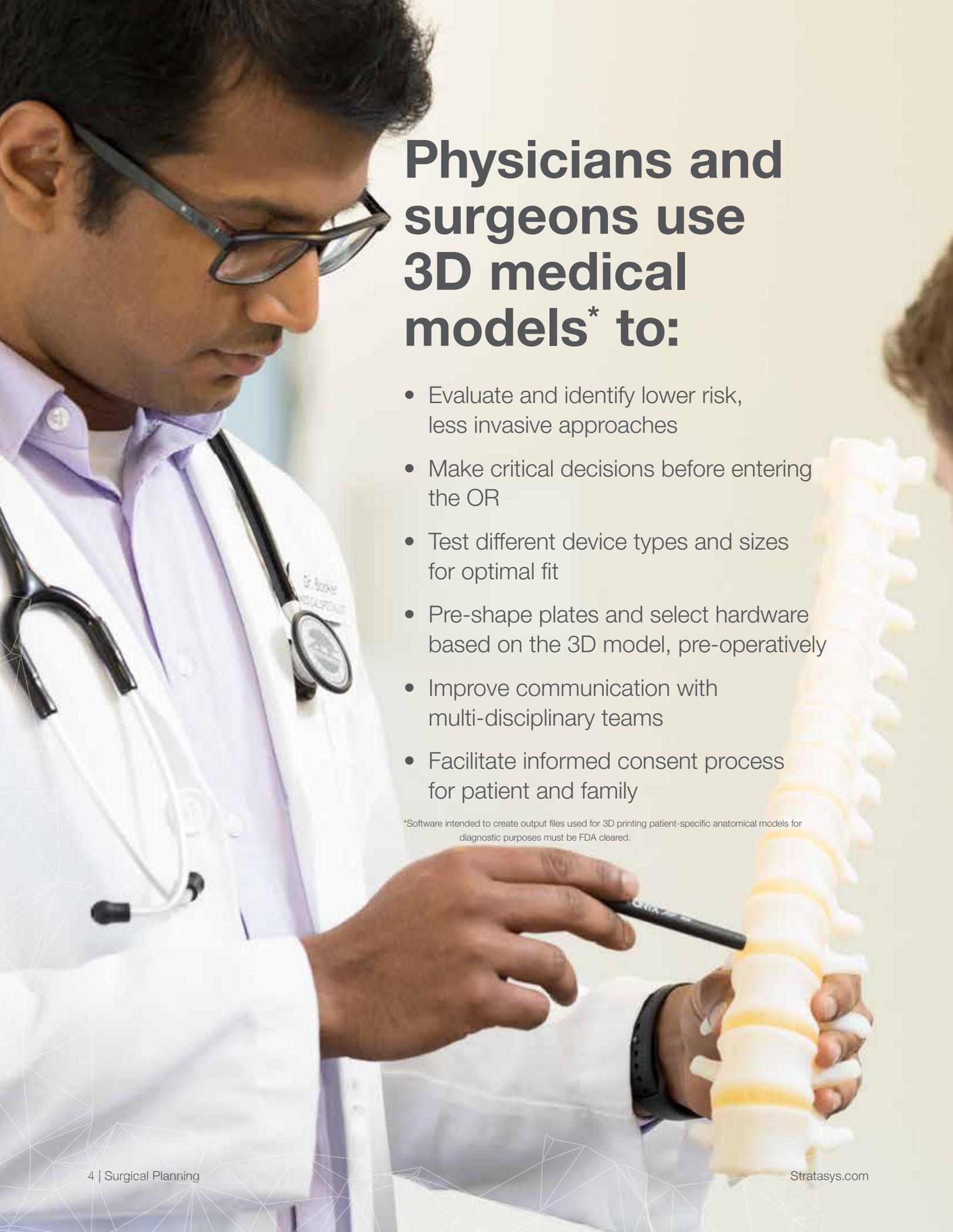
3D printed medical models help surgeons refine their clinical approach before surgery.

Gain shorter procedure time, fewer complications and faster recovery.

Confirm

3D printed medical models help ensure the planned procedure is case-appropriate.

Gain 3D view of patient's anatomy and pathology.



Physicians and surgeons use 3D medical models* to:

- Evaluate and identify lower risk, less invasive approaches
- Make critical decisions before entering the OR
- Test different device types and sizes for optimal fit
- Pre-shape plates and select hardware based on the 3D model, pre-operatively
- Improve communication with multi-disciplinary teams
- Facilitate informed consent process for patient and family

*Software intended to create output files used for 3D printing patient-specific anatomical models for diagnostic purposes must be FDA cleared.



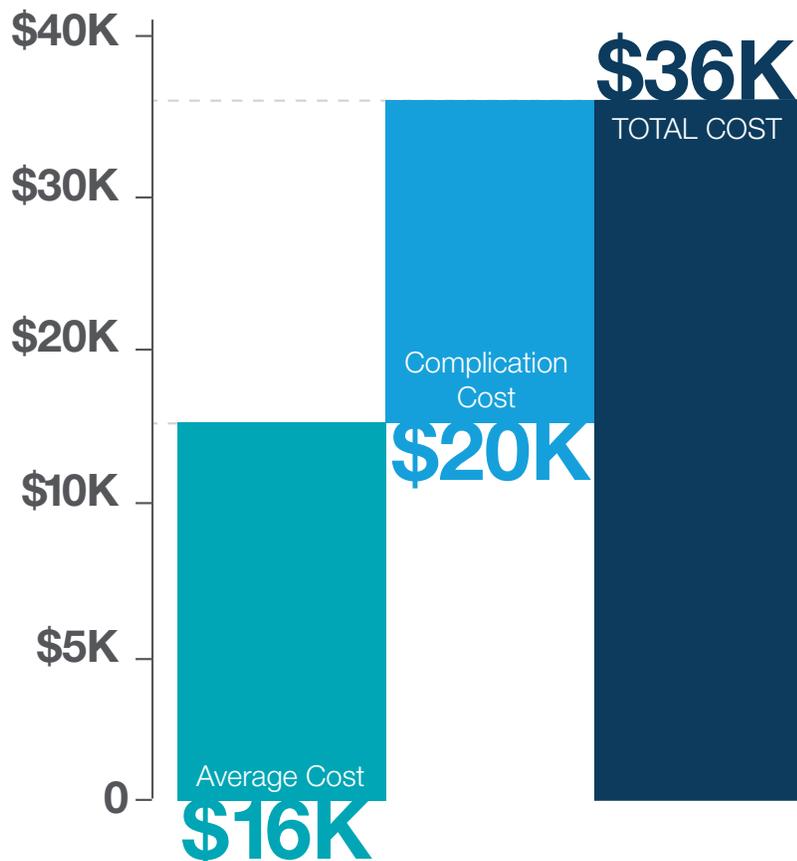
1 out of every 6

**surgeries will result
in complications**

3D Printed Medical Models Help

**Reduce Complication Rates
and Lower the Cost of Care**

**Mean hospital costs are 119% HIGHER
for patients with complications¹**



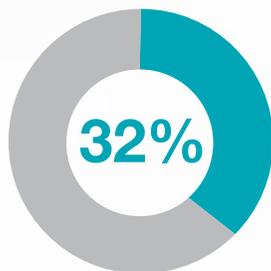
The Stratasys Difference

- High resolution to print fine anatomy
- High accuracy
- Full color to differentiate anatomy
- Transparency to see internal structures
- Combine soft tissue and hard bone in a single model

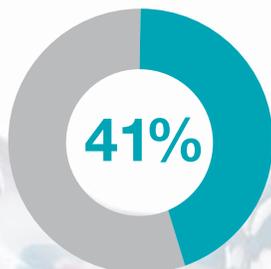
Other Uses for Medical Models

- Education and training
- Recreate complex and challenging cases for residents and fellows to practice on
- Innovation: bring hospital staff ideas to life with rapid prototyping
- Custom tools: create research and clinical tools to meet surgeons' needs

Use of 3D models during pre-procedure planning for left atrial appendage occlusion surgeries reduces the number of devices per procedure.²



3D models used to prepare for double outlet right ventricle surgeries results in a shorter stay in the ICU.³



Use of pre- and intra-operative real size 3D models for fixation in tibial plateau fractures results in shorter OR time.⁴



Real-World Impact

Congenital Heart Disease

Nicklaus Children's Hospital, Miami, FL

A one-of-a-kind heart anomaly made 4-year-old Adenelie Gonzalez's total anomalous pulmonary venous connection a high-risk surgery surgeons were reluctant to take on.

A 3D printed medical model of Adenelie's exact malformation enabled Dr. Burke to visualize an operation to safely approach the procedure. From the 3D model, he was able to configure the patches necessary to repair her vasculature and match the exact shapes and dimensions of her deformed pulmonary veins.



“3D printing helped me take somebody from being inoperable to operable, and we've saved her life.”

Raymond P. Burke, M.D.

**Nicklaus Children's Hospital
Cardiovascular Surgery**

“Based on the Stratasys 3D model, we were able to pre-empt potential complications and devise a more optimal means of treating Teresa's aneurysm.”

Dr. Adnan Siddiqui

**The Jacobs Institute,
Department of Neurosurgery**



Stratasys printed 3D cerebral aneurysm model

Cerebral Aneurysm

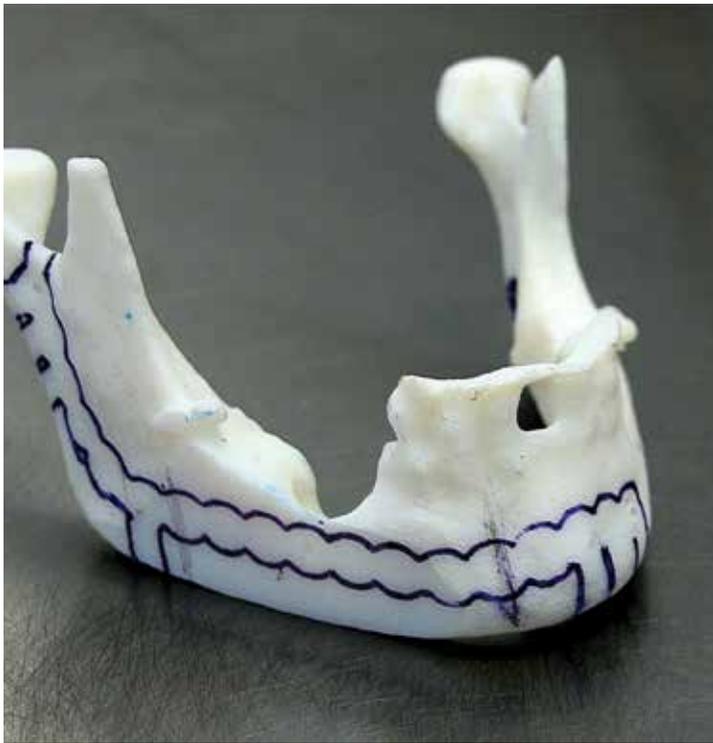
Kaleida Health's Gates Vascular Institute, University of Buffalo, and The Jacobs Institute, Buffalo, NY

A 49-year-old mother of three presented with an extended period of inexplicably diminishing vision. The determination was Teresa suffered from a cerebral aneurysm. Based on the 2D imaging, the team selected an aneurysm embolization device and attempted to deploy the chosen device into the 3D printed model. During this test they discovered the solution would not succeed.

Maxillofacial Surgery

Queen Elizabeth's Hospital, Birmingham, U.K.

Severe cases requiring maxillofacial surgery to hold facial bones in place can be a lengthy process when employing off-the-shelf anatomical models to fit a patient's unique measurements. Surgeons at Queen Elizabeth's Hospital began using 3D printed patient-specific models for pre-surgical planning.



“The ability to produce lifelike medical models in-house on our **Stratasys 3D printer** saves around **3 to 4 hours in OR time**, per surgery, which at a cost of £5,000 (\$6,499.50) an hour of operation room time, is quite a substantial cost saving.”

Steven Edmondson

**Consultant Maxillofacial Prosthetist,
Queen Elizabeth Hospital, Birmingham, U.K.**

1. Healy, M. A., Mullard A. J., Campbell D. A., Dimick, J. B. Hospital and payer costs associated with surgical complications. *JAMA Surg.* 2016;151(9):823-830. doi:10.1001/jamasurg.2016.0773.
2. Obasare E et al. CT based 3D printing is superior to transesophageal echocardiography for pre-procedure planning in left atrial appendage device closure. *Int J Cardiovasc Imaging.* 2018; 34(5):821-831.
3. Zhao L, Zhou S, Fan T, Li B, Liang W, Dong H. Three-dimensional printing enhances preparation for repair of double outlet right ventricular surgery. *J Card Surg.* 2018 Jan;33(1):24-27. doi: 10.1111/jocs.13523. PubMed PMID: 29409167
4. Giannetti S et al. Minimally invasive fixation in tibial plateau fractures using an pre-operative and intra-operative real size 3D printing. *Injury.* 2017; 48(3):784-788.

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