



Surgeons practice suturing on a Stratasys advanced medical models 3D printed heart model.

Stratasys Advanced Medical Models Enhances Training on Rare Pediatric Heart Surgeries

Advanced 3D Printed Materials Mimic Real Hearts

Becoming a surgeon takes years of practice. Becoming a pediatric heart surgeon takes even more. Surgical training begins with a new surgeon looking over the shoulder of a practicing surgeon before moving on to practice on cadavers or animals. Though hands-on, these training scenarios are often imperfect due to lack of complex pathology, expense and repeatability. Nevertheless, the importance of surgical practice cannot be underestimated. In fact, Dr. Glen Van Arsdell, head of cardiovascular surgery at The Hospital for Sick Children (SickKids), in Toronto cites a direct correlation between volume of practice and outcomes in difficult surgeries.

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These 3D printed models have tremendous value in developing surgeons' skills...students agreed the 3D printed heart models were tremendously helpful for them.”

Dr. Shi-Joon Yoo

head, pediatric cardiac imaging, The Hospital for Sick Children



New, flexible material allows for greater realism and feedback when training on a 3D printed pediatric heart model.



Early 3D printed medical models attempted to bridge this gap in availability and training. The ability to practice in a no-risk setting, on a model closely approximating the human body, gave surgeons the ability to envision anatomy in three-dimensions. Although helpful, these models still lacked the realism, haptic feedback, and functionality to enable practice in a laboratory setting. Dr. Shi-Joon Yoo, head of pediatric cardiac imaging at SickKids, became interested in 3D printed medical models some years ago to help enable education and training. He persisted even though one impediment to success remained; most 3D printers were only capable of printing hard materials.

According to Yoo, the role of the radiologist is to “provide the precise image information necessary to make the right treatment decision, and then facilitate these procedures.” Scans and images satisfy the first half of his job description; Yoo believes improved 3D printed medical models with soft materials are the answer to the latter.

New Surgical Instrument

“Human organs are complex, with combination structures,” said Yoo. “It’s very difficult to tease out all the different elements and replicate them. During one of the SickKids ongoing simulation training courses, Yoo realized “what I needed was a 3D printer capable of printing flexible models.” He worked with Stratasys to develop a way to print 3D printed pediatric heart models in-house. “We now have Yoo is equally enthused about the new material. Surgeons responded, saying ‘it’s almost like the real thing,’” said Yoo. “In the past year, we’ve had the opportunity to have a direct relationship with the Stratasys team, helping to develop the material and models for application in congenital heart disease cases.” Surgeons are also able to practice for other complex procedures as well, such as transposition of the great arteries. “For the first time in history, we are providing the capability to 3D print clinical scenarios that are problematic and challenging,” said Yoo, “and with a softer, more realistic material.”

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Dr. Van Arsdell working with surgeons-in-training on a simulated cardiac procedure.

“The reality of training on anatomically accurate, realistic models finally became a reality. [Stratasys advanced medical models](#) are anatomically accurate, have the ability to mimic various pathologies, and provide true haptic feedback for surgeons in-training,” said Van Arsdell. “Stratasys asked if they could partner with us to advance our efforts. They came and printed some models for us and we ended up with models that actually had better tissue quality. We’re making progress on mimicking something much closer to real human feel,” said Van Arsdell.

“We practice some very complex surgeries such as hypoplastic left heart syndrome,” said Van Arsdell. “These are tough operations to do, involving complex three-dimensional geometry using patches. It’s just fantastic for these trainees to have an opportunity to get the feel of it and learn to cut patches and learn the sequencing on models instead of learning it on a baby. All the moves are the same, so that when a surgeon does it on a baby, it’s much more familiar and much safer.”

Patient mortality rate for this procedure at SickKids is significantly lower than average. “Are we better surgeons?” said Van Arsdell. “I don’t think so. The difference is practice. The more opportunity a surgeon has to practice before a procedure, the better the outcome.”

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