



# Hands on Heart

How Somos® and Stratasys Direct Manufacturing are improving heart surgery

The heart is an extremely complex organ. As the physicians at the Texas Cardiac Arrhythmia Institute (TCAI) can attest, no two human hearts are exactly the same.

Due to the organ's complexity, it is virtually impossible for even the most brilliant physician to diagnose a heart condition without extensive imaging of the patient's heart. Even with the incredible progress made in obtaining results from CT scans, echocardiograms and ultrasounds, cardiologists agree that there is no comparison for being able to see an actual model of a specific patient's heart in question—one the doctor can physically hold in their hands.

Dr. Vikram Devaraj, Director of Solid Materials Research for the Texas Cardiac Arrhythmia Research Foundation, had the idea to improve upon the preparation for open-heart surgery by using 3D-printing technology to give the physicians at TCAI access to anatomically accurate representations of their patients' hearts. "Dr. Horton, Dr. Beaman and I came together on this project to figure out a way to make additive manufactured models of the heart from direct CT scans," Dr. Devaraj explains.

However, without the budget, capacity or expertise needed to own and operate an additive manufacturing system, Dr. Devaraj and TCAI turned to Stratasys Direct Manufacturing for their expertise and guidance in additive manufacturing, along with the security in knowing their files would be handled safely and confidentially. Stratasys' ability to print models of patients' hearts on demand, with extreme precision and rapid

turnaround only made Dr. Devaraj and his team more confident in the success of the project.

As Dr. Devaraj explains, the CAD (Computer-Aided Design) files used to create the models are taken directly from the patient's CT scans so the printed heart model is an extremely accurate representation of the patient's own anatomy. Stratasys Direct Manufacturing then optimizes the CAD file for 3D printing and uses Stereolithography (SL) technology to build the models. SL uses UV lasers to cure liquid resins layer by layer and is among the most precise 3D printing technologies.

"We chose to produce the models with Somos® WaterShed XC 11122 due to its clarity and precision," says Chuck Alexander, Director of Product Management at Stratasys Direct Manufacturing. "When examining the 3D printed model the clarity provides doctors and patients a chance to see intricate internal valve structures and better prepare for the procedure. In addition, this material has a high level of dimensional stability which is critical as the model must retain its proper dimensions."

"It was suddenly a way to look at the internal organs without having to open someone up. And frankly, even if you open someone up, it's not the same; it doesn't look the same.

Having this type of 3-dimensional mapping and printing of an actual heart of that particular patient is invaluable in speeding up and improving safety and efficacy of the procedure,” explains Dr. Rodney Horton, M.D., F.A.C.C., Cardiac Arrhythmia Specialist, who worked alongside Dr. Devaraj to bring his idea to life. “Not only has it made my work with patients better and my clinical practice better, but it has opened up the opportunity for improving on medical devices themselves, coming up with applications you wouldn’t have otherwise thought of because you can spin the model around in your hand and see connections and geometric orientations that you wouldn’t have recognized before.”

Stratasys Direct Manufacturing works directly with TCAI on an ongoing basis in order to produce hearts printed from CT scans. The hearts are printed and delivered to the physicians in a matter of hours, enabling the physicians to study the models before performing open-heart surgery on a patient.

As Dr. Horton puts it, “If a surgeon needs to repair something, they have this in their hand before they open up the chest. So it’s enormously valuable from that standpoint.”

The ability to produce unique patient models is just one way additive manufacturing has shifted the health care industry away from a one-size-fits-all approach to more customized solutions for improving outcomes. Freed from the design and capital constraints of traditional manufacturing—and with further advancements in additive materials from Somos® and processes from Stratasys Direct Manufacturing—doctors and medical institutions will continue finding new ways to provide better care for all of us.



Inspecting the heart.