

YOUR GOOD HEALTH

3-D Hearts

Technology helps doctors diagnose and treat heart patients

By Judith Graham

Kaiser Health News

Emmanuel Ellis has had a heart defect since he was born, undergoing surgeries as a baby and again as a teenager.

But it wasn't until this year, when he was getting prepared for another procedure at Nationwide Children's Hospital in Columbus, Ohio, that the 30-year-old Lima man finally understood just what was causing the problem.

The eye-opener came when Dr. Darren Berman pulled out a transparent, flexible model of Ellis' heart, showing the two tubular grafts used to reconstruct his aorta and the calcium that had built up to cause severe narrowing in those tubes.

"That helped out a lot," said Ellis, who was treated as part of a Nationwide Children's program for adults born with heart disease.

"For me to see it, as plain as it was, it was right there in front of me."

The model, made on a 3-D printer and based on CT images of Ellis' heart, is an example of the way radiologists and surgeons are teaming up to use technology to diagnose and treat heart patients.

Models are made in the hospital's \$350,000 3-D printing lab, which opened about a year ago. There, a team translates 2-D ultrasound, CT or MRI images into 3-D images, which are then used to create programs that tell the printer how to form replicas of patients' hearts.

"It creates not only a pretty model to look at, but allows us to pre-procedurally plan what we think is best for that patient," said Berman, who co-directs the cardiac catheterization and interventional therapy program at Nationwide Children's Heart Center.

What is 3-D printing?

3-D printing is a manufacturing technique by which objects are built from digital data in a way similar to how computer text is printed on a page. Material is joined or solidified under computer control to create a three-dimensional object. It offers flexible, inexpensive manufacturing for widespread use. 3-D printers have been used to build a variety of things from rockets to houses to guns to even other 3-D printers.

Source: The Shape of Things to Come, 3D Printing in Medicine, JAMA 2014

<https://jamanetwork.com/journals/jama/article-abstract/1983687?redirect=true>

Other medical uses for 3-D printing include:

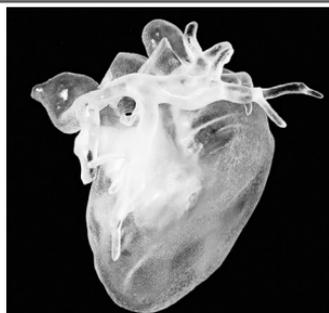
- Low-cost, high-quality prosthetic limbs and orthotic braces
- Replacements for bony body parts: knees, hips, ankles, parts of the spine, and skull
- Customized protective devices and aids such as dental implants, hearing aids, prescription eyeglasses and headgear

Source: ASME, May 2017, <https://www.asme.org/engineering-topics/articles/manufacturing-design/top-5-ways-3d-printing-changing-medical-field>

In Ellis' case, Berman used the model to come up with a plan to use four stents to reopen the grafts. He also was able to practice the procedure, determining ahead of time how the stents would react to the calcium build-up.

"Three-D printing is not necessarily needed on every single patient," Berman said, "but it plays an important role in the most complex hearts, where we and everybody else in the country and the world still struggle with what is the right decision-making for that patient."

Three-D printing is the



A 3-D printed model of a newborn heart at Nationwide Children's Hospital in Columbus, Ohio. Doctors at the hospital are using imagery and 3-D printers to create models of patient hearts to help them prepare for surgeries.

[JOSHUA A. BICKEL/DISPATCH]

"next generation of medicine," said Dr. Kan Hor, director of cardiac MRI at the Heart Center. It got its start in the dental industry and has become more common in other areas over the past five years, he said. Children's hospitals tend to use it more because pediatric heart-disease cases can be unique or vary widely from one child to another.

The printer takes several hours to create the models and can use different materials and colors. Using silicon-based materials, it builds the models in layers, each thinner than a hair, said Brad Hoehne, 3-D printing and conference coordinator.

The next step is to improve on the materials, to make the models as close to human tissue as possible. In Ellis' model, for example, two materials were used — a more flexible material for the tubing and a harder one to represent the calcium build-up.

Dealing with heart disease used to be primarily about saving lives, Berman said. But now it's more about giving heart patients the best quality of life possible, and minimizing the potential for future operations. Models can assist surgeons in achieving those goals, by helping them do things properly the first time or giving them an opportunity to determine innovative ways to fix problems, he said.

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