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## 3D-Printed Hearts Help Surgeons Save Babies' Lives

Replicas of the human heart that are made on 3D printers could help save babies' lives, new research suggests.

The [heart](#) replicas are designed to match every tiny detail of a baby's heart, so they can help surgeons plan where to cut tissue, reroute piping and patch holes in children with congenital heart defects, researchers said. The new findings were presented today (Nov. 19) at the American Heart Association meeting in Chicago.

Though just a handful of such hearts have been used so far, the replicas have already revealed hidden Swiss cheese-like holes in one child's heart, and in another case, inspired a repair strategy that dramatically extended the baby's projected life span.

"From the first two cases straight out of the gate, we've had this dramatic impact," said study co-author Dr. Matthew Bramlet, a pediatric cardiologist at the University of Illinois College of Medicine and the Children's Hospital of Illinois, both in Peoria.

### **Tiny hearts**

Children who have certain [congenital heart defects](#) — such as holes in one of the four chambers of the heart or misrouted arteries and vessels — often face years of complex, risky surgeries. When these fragile babies are born, doctors typically do a very quick surgery that improves blood flow just enough for them to grow. Once the little ones have doubled in size (usually when they are 6 to 9 months old), surgeons often perform more complicated repair surgery, Bramlet said.

But even the hearts of bigger babies are tiny, and the magnetic resonance imaging (MRI) scans that are currently done to guide surgical decisions are difficult to interpret. Although researchers have [3D-printed an artificial heart sleeve](#), [an artificial wind pipe](#) and replicas of kidneys and livers to guide surgeries, 3D replicas of the heart were slower to come along, Bramlet said.

### **Holding the heart**

So Bramlet and his colleagues began using detailed MRIs to design anatomically accurate replicas of the heart that were then printed at the Jump Trading Simulation and Education Center, also in Peoria.

Almost immediately, the printed hearts helped guide surgical decisions. In the very first case, doctors believed that a baby had a single hole in the wall of one of the heart's

ventricles, based on the MRI images. This kind of defect, called a ventricular septal defect, is usually patched up with a fairly straightforward technique. But the 3D-printed heart clearly revealed several Swiss-cheese-like holes in the heart that also had to be closed.

The realization helped the surgeon rethink his strategy, which reduced how long the heart had to be stopped during the surgery, Bramlet said.

In the second case, a baby had problems with the major arteries emerging from the heart's right ventricle, as well as several holes in the heart. Normally, with the procedure used to fix these defects, doctors destroy so much heart tissue and reroute blood flow so dramatically that they essentially reduce the heart to two functional chambers. But in this case, by looking at the anatomy in 3D, the team was able to find a better work-around and spare all four of the heart's chambers, which increased the baby's [life expectancy](#) from 20 to 30 years to near-normal, Bramlet said.

"Holding [the heart] in her hand, the surgeon could much, much more easily determine how to appropriately perform that surgery," Bramlet told Live Science.

Since the first repair, the team has gone on to create eight or nine heart replicas, and all of them have improved the surgeon's understanding of the heart anatomy prior to the surgery, he said.

But the total number of hearts they've studied so far is small, so it's too soon to know whether the heart replicas improve surgical outcomes, Bramlet said. Because these complicated heart defects are rare, researchers would need to set up a clinical trial at multiple sites to get enough cases, Bramlet said.

## Could 3D Printing Spark a Gun Battle?

The wonders of 3D printing, and the technology's potential to revolutionize the world of manufacturing, have thrilled entrepreneurs, tinkerers, government officials and the business community.

But a few skeptics aren't jumping on the 3D-printing bandwagon quite so enthusiastically, and have warned that there's a dark side to [3D printing](#) — particularly the ease with which people could make their own 3D weapons.

Last Thursday (Nov. 21), Philadelphia took the proactive measure of banning guns made by 3D printing, also referred to as additive manufacturing. The City of Brotherly Love reported 331 murders in 2012, according to FBI statistics, making it one of the deadliest cities in the United States. [[The 10 Weirdest Things Created By 3D Printing](#)]

The possibility of homemade guns has aroused the ire of gun-control advocates as much as it's sparked the excitement of gun aficionados. In 2012, a former University of Texas law student

named Cody Wilson alarmed law enforcement officials when his nonprofit organization, Defense Distributed, posted plans on the Internet for making a 3D-printed plastic gun.

### **Evading metal detectors**

Wilson's gun, the so-called "Liberator," is made of ABS plastic and is capable of killing someone, according to test results from the U.S. Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF).

"The bottom line is, the penetration results demonstrated that the Liberator is a lethal weapon," Earl Griffith, chief of ATF's firearms technology branch, told the [Huffington Post](#). "The .380 bullets fired from the Liberator penetrate sufficiently to reach vital organs and perforate the skull."

Plans for making the Liberator were downloaded more than 100,000 times before federal officials stepped in and ordered Defense Distributed to remove the online information earlier this year. Because it's made of plastic, the gun could slip past metal detectors and into courtrooms, government offices, airports, schools and other venues where firearms are strictly prohibited.

### **3D printers: silly to sublime**

Most uses for 3D printing run the gamut from the essential to the silly. Medical researchers are hoping to make customized [human organs like hearts](#) within a decade, reducing the need for donor-organ transplants. Designers in Australia have developed a [3D-printed horseshoe](#) made of titanium, and dessert chefs in Japan have discovered a way to create a customized, 3D-printed version of a person's face made of chocolate.

But the threat of plastic guns slipping past security desks and into federal buildings or criminal courtrooms has alarmed officials at all levels of government. Rep. Steve Israel (D-N.Y.) is sponsoring a federal bill that would update a law banning undetectable firearms to include language addressing 3D-printed weapons.

While Israel's bill appears to be stalled in a House committee, a similar bill sponsored by Sen. Chuck Schumer (D-N.Y.) is wending its way through the Senate, according to the [Washington Post](#).

### **Heavy metal**

And gun-control advocates who worry that a rash of deadly plastic weapons will soon be unleashed on helpless citizens now have a new fear: 3D-printed guns made of metal, designed by a company called Solid Concepts. The plastic Liberator has shattered in some tests, but the metal guns — made with a 3D-printing process known as direct metal laser sintering, or DMLS — appear to be sturdy and reliable.

The concern that these guns could be made and used by people who would fail a standard background check — felons, wanted criminals, certain individuals with a history of mental health problems — has added to the impetus for some kind of control on their use, even if measures like Philadelphia's are largely symbolic.

"It's all pre-emptive," Steve Cobb, director of legislation for Philadelphia Councilman Kenyatta Johnson, told [Philadelphia magazine](#). "It's just based upon Internet stuff out there."

Write one paragraphs for each article explaining how 3d printing is making changes in the world.