

# Kids get new hands made with 3-D printers

October 3 2014, by Meredith Cohn, The Baltimore Sun

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Trauma surgeon Albert Chi gave a talk last year to families about advanced prosthetics that would someday benefit their children who were missing hands.

But when a parent asked what was easy, available and affordable now, Chi was stumped. After focusing on the latest artificial limb technology, he began to hunt for more basic options.

Like many researchers, entrepreneurs and even artists in recent years, he turned to the 3-D printer. With one his wife bought him for Father's Day, sheets of colored plastic, and free designs and advice found online, he made a [hand](#) for about \$20.

"One of the first kids we fitted was a 2-year-old," Chi said. "We thought the child was too young, but we weren't even able to finish strapping it on, and the kid was picking an object up."

The need for such prosthetics has spawned a network of volunteer designers, medical workers, artists, engineers, parents and 3-D print enthusiasts who have been outfitting children with prosthetics - some with lower-end machines that cost less than \$1,000.

That network is hoping to give hands - free of charge - to any interested child. It includes the nonprofit e-NABLE, the largest and perhaps only organization matching kids with printers.

The organization has provided more than 400 kids with printed

prosthetics over the past year. In addition, with designs that are free on the e-NABLE's website, families may be printing their own.

The 3-D printed prosthetics are particularly useful for children. They often grow out of prosthetics and can't afford replacements every few months or years. The 3-D versions also can be lighter and easier to wield - and come in their favorite colors.

The U.S. Centers for Disease Control and Prevention reports that four in 10,000 children are born with some congenital hand loss, or about 1,500 a year. That doesn't include those who lose their hands in accidents.

Insurance also doesn't always cover pediatric prosthetics, which cost up to \$40,000, said Chi. And children can have trouble adjusting to them.

Griffin Matuszek, who was born without part of his left hand, found his traditional [prosthetic](#) mostly useless and a bit scary, said his mother, Quinn Cassidy. So she began researching alternatives.

When someone sent the family a link to Chi's work on 3-D hands, Cassidy's father called the doctor. Griffin's family came from North Bethesda, Md., to Baltimore to get his first printed hand. The 5-year-old requested one that glowed in the dark.

Cassidy said Griffin was drawn to his new hand because he could put it on himself and easily manipulate it with his palm muscles. The traditional prosthetic was tight and covered his forearm.

"He put it on and immediately gave Dr. Chi a high five and then gave everyone in the room a high five," Cassidy said. "He was able to pick up a small ball and throw it with his left hand right away."

Cassidy said the hand made Griffin happy and more confident, and

didn't break her bank. The old prosthetic was covered by insurance, but her co-pay was \$1,000. She was so grateful to Chi that she pledged to cover the cost of a 3-D printed hand for another child every time Griffin got a new one.

Another recipient was Mike Waldron, 22, a senior political science major, at the University of Maryland, Baltimore County.

"It gives me many options. I can go kayaking and work on my cars now," said Waldron, who said an electronic prosthetic device could cost as much as \$40,000, while the one he received at Hopkins, was in the \$45 range. "It's all plastic and the only metal is the screws. The string is 40-pound test fishing line."

John Fielding, a 7-year-old from Arlington, Va., was looking forward to being able to play the guitar one day and ride a bike.

"Now, I can fight my sister," he said, laughing.

The printers work like glue guns, as plastic sheets are fed into the machines and melted. The plastic comes out in layers that eventually look like Lego pieces, fitted together with plastic bolts that also are printed.

Hand parts take up to 10 hours to print and another couple of hours to assemble with elastic cords to keep the hands open. Kids make them grasp by flexing their palms or wrists. Extra cords can be used to strap them on kids with more extensive limb loss.

Chi, a [trauma surgeon](#) at Johns Hopkins Hospital, called the effort a "labor of love."

A senior prosthetist at Children's Healthcare of Atlanta, Brian

Giavedoni, said he uses traditional prosthetics but sees a place for 3-D printed hands.

Younger children don't always see a need for a prosthetic and find them cumbersome, as they have found ways to function without a limb or hand, he said. Some don't see the need for both hands for school work and activities until they are teens. And parents often want the most advanced prosthetic, which can be overwhelming.

"If I told you that when you get home tonight you'll need a hammer but you have to carry the hammer all day, you'd reject that, and that's how kids can see it," Giavedoni said. "But I guarantee you at some point they'll want a prosthetic."

Getting younger kids to wear them helps them learn, tone their muscles and prepare them for more advanced equipment down the line, he said. It also could help make the case to insurers that prosthetics are needed.

Printers have been used for other types of prosthetics, but hands designs were more difficult to develop because of the specific movements such prosthetics are required to carry out, designers say.

Hand designs proliferating online can be traced to two men who collaborated online in 2011 from their respective locations in Bellingham, Wash. and South Africa. The South African, Richard Van As, was a carpenter who accidentally severed some fingers. He couldn't afford a prosthetic, so he jury-rigged something but needed help making it more useful.

He found a prototype online, a giant puppet that used metal cables for tendons, and contacted the prop maker Ivan Owen.

After Skyping for some time, Owen flew to South Africa to finish the

job. Then a local mother asked for a prosthetic hand for her 5-year-old son, so they made him one too. They eventually replaced the hands with better 3-D printed versions they called Robohands.

They put those designs online for free, hoping others would continue to improve and share them.

A research scientist at the Rochester Institute of Technology, John Schull, later founded e-NABLE to moderate the community and match needy kids with people willing to print the hands. (The group recommends consumers get their doctor's input.)

"The goal is to make these devices as accessible and useful as possible," said Owen, who was recruited by the University of Washington to work on 3-D technology for medical devices full-time. "It's a powerful experience watching someone use a new hand."

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