

HEALTH CARE | INNOVATION

THAT TINY OBJECT in Todd Goldstein's hand is a trachea scaffold, made on a desktop 3-D printer, for a rabbit.

Beyond science fiction

Bionic hands, implants made of synthetic bone. Researchers in New York are using 3-D printers to create the next breakthroughs in medicine

BY CAROLINE LEWIS

Todd Goldstein is only a 29-year-old Ph.D. candidate, but he is working on the front lines of medical research, using 3-D printers to produce bionic hands, implants made of synthetic bone, living organs and a range of other creations.

A student at Hofstra Northwell School of Medicine, he is working closely with Dr. Daniel Grande, director of orthopedic research at Northwell Health's Feinstein Institute for Medical Research on Long Island. Goldstein picked up the coding he uses for 3-D printing online, and brims with ideas for how hospitals can capitalize on the promise of the technology.

"A little engineering can go a long way," said Goldstein, who prints trachea made of living cells using a modified Replicator 2, a desktop 3-D printer made by Brooklyn-based MakerBot.

Most of what Goldstein and Grande are doing is not completely novel, but they hope to turn their 3-D printing skills into a business. The two are currently in talks with North Shore Ventures, the venture-capital arm of the health system formerly known as North Shore-LIJ, about creating a 3-D printing center to distribute their custom devices to physicians in the Northwell network and beyond.

The pair will start small, selling the custom drill guides they've already started creating for dentists. Each one costs about \$2 to print, plus labor.

It will be several years at least before 3-D-printed organs make their way into human bodies. But with the ability to rapidly prototype and test new designs, progress could come fast. Rabbits have already received successful transplants with the tiny trachea Goldstein and Grande produced on one of the machines MakerBot donated to their lab.

Many consider MakerBot's printers, which cost less than \$2,000, well below standard for medical purposes. But, Goldstein said, he has no idea why anyone would shell out 100 times as much for printers marketed to the medical field.

To print the trachea, Goldstein fit a cubical desktop printer made by MakerBot with a syringe that spews bio-ink, a viscous material made of living cells. The nozzle that comes standard on the machine emits an organic plastic called PLA, which creates the scaffold of the trachea. It's just a few dollars' worth of plastic, said Goldstein, holding the scaffold between his pointer finger and thumb, and it can biodegrade in the human body, so just the organ is left. The same plastic can be used to manufacture cutting guides like the ones doctors employed to reconstruct Zees Stern's jaw. (See story, Page 16.)

The Feinstein Institute's trachea experiments were sparked by an inquiry from a pediatric surgeon in the health system who has patients suffering from stenosis, a potentially fatal narrowing of the airway.

Replacing body parts

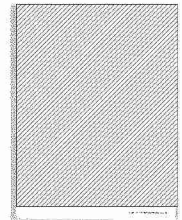
"Before 3-D printing, there was no way we could make a trachea ideally fitted for a 2-year-old," said Dr. Lee Smith, chief of the division of pediatric otolaryngology at the Cohen Children's Medical Center. Or rather, he said, it would theoretically have been possible, but would have taken millions of dollars to engineer and there would have been no guarantee it would work.

The advent of 3-D printing has made it not only possible to test medical solutions on the fly, but practical as well.

"Our little activity here at the Feinstein Institute has spawned [about] 10 different hospital departments coming to us asking us to help them use 3-D printing technology," said Grande.

Goldstein said he envisions a new normal in which doctors are able to print emergency implants of organs and bones, leaving no patient wanting for new parts. "Imagine having a 3-D printer in every emergency room," he said. "You could print replacement parts on demand."

He marveled at the possibilities. "I think that would be a very nice future." ■



BUCK ENNIS