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News for Your Neurons

# Virtual Reality Could Keep You From Being a Surgical Guinea Pig

By Hadley Leggett [✉](#) August 10, 2009 | 3:52 pm | Categories: [Biotech](#), [Health](#), [Medicine](#)



New pilots train on flight simulators before flying their first 757. Scientists experiment on animals before giving their new drug to patients. And fledgling surgeons perform their first few operations on... real people.

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Now, a small but growing group of doctors are trying to make surgical training safer by bringing virtual reality into the operating room, and taking the trial-by-error out.

“You can imagine in aviation if a copilot just sat there watching what the pilot did, and then did a couple of little things here and there,” said orthopedic surgeon Dilworth Cannon of the University of California, San Francisco. “I don’t think the passengers would feel very confident when he was given his first plane to fly.”

But Cannon says that’s the way most new surgeons currently learn their craft: by observing a senior doctor in

the operating room, helping out with small tasks at first and then gradually taking over more and more of the surgery. No one wants to be the first patient a new doctor operates on, or even the test case for an experienced surgeon who's trying out a new technique. At the moment, however, there's no good alternative to the "see one, do one, teach one" system of medical training, Cannon says.

Practicing on a cadaver can provide some valuable experience, but there often aren't enough good specimens to go around. "You might be lucky to get two or three procedures out of a cadaver," Cannon said. "With virtual reality simulators, you can keep using them over and over."



The idea of learning to operate on a virtual patient — the surgical equivalent of the flight simulator — has been around for decades, but only recently has virtual technology become powerful enough, and cheap enough, for surgical simulators to become a practical option. The latest devices have touch-feedback systems that let practicing surgeons not just see and hear their virtual patients, but also feel the sensation of pressing a scalpel against muscle or drilling into bone.

This week, Stanford researchers report they've taken virtual surgery one step further, by integrating data from individual patients' pre-op CT scans to create patient-specific models. So far, they've done virtual practice sessions with their prototype on several patients about to undergo sinus surgery.

The new simulator consists of a small surgical camera, called an endoscope, and a mannequin head attached to a commercially manufactured touch-feedback device. As a doctor manipulates the endoscope through the nostril of the mannequin, he watches what's happening on a computer screen above the "patient." A computer program calculates how much resistance should be applied to the endoscope based on its location in the sinus cavity.

Because the device can simulate the anatomy of a specific patient, researchers hope it will be useful not just for new doctors, but also for senior surgeons who want to practice different approaches before a particularly challenging case.

Uploading patient CT data into the computer takes about 20 seconds, and the whole set-up costs less than \$10,000, said surgeon Nikolas Blevins of the Stanford University School of Medicine, who co-authored a paper about the simulator published this month in the *Journal of Rhinology and Allergy*.

"In the past, devices were extremely expensive and extremely cumbersome," Blevins said. "But now with the availability of commercial devices, these kinds of systems can be put on an average desktop or operating room and can be used by whoever needs it whenever they want it."

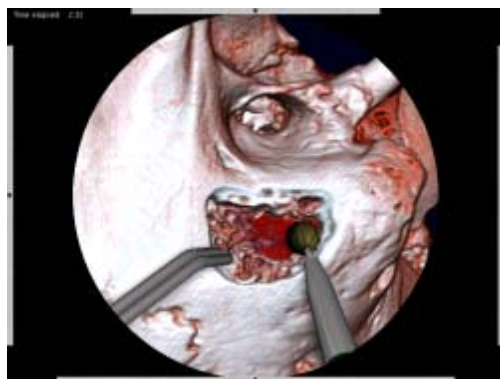
Blevins called the simulator a "reasonable representation" of what surgeons see and feel during a real operation, but he said the simulation is far from perfect. The device can sense motion in six different directions and give touch feedback in three, but that's only enough to simulate simple surgical instruments, such as a drill, suction tube or camera.

"Interactions with tissue forceps and other kinds of graspers are more complicated and will take additional

refinement,” Blevins said.

So far, virtual devices have been most successful at simulating closed procedures, like sinus surgery, where surgeons operate through the nose, or laparoscopic surgery, where they enter via small holes cut in the abdomen. Open surgeries are much harder to mimic using virtual reality, because movement happens in all directions and much of the procedure involves directly touching the patient.

“We’re just a few million years behind the design of the human hand,” said virtual anatomy expert Don Stredney of Ohio State University. “All the subtleties that you experience with the hand, the technology is just not there yet.”



Stredney and colleagues at the [Ohio Supercomputer Center](#) have been working on a virtual reality simulator for inner ear surgery, which involves drilling into a bone in the skull called the temporal bone. Because the temporal bone lies close to a major artery and critical nerves for the face, learning to perform the surgery can be tricky.

“For temporal bone surgery, you really need an integration between different senses,” Stredney said. “You need to see what you’re doing and to feel the resistance on the drill, especially around neural tissues where you could really do some damage by heating bone near a nerve or breaking through a structure.”

Surgeons also need to be able to hear and interpret the sound of the drill, he said, because the pitch changes depending on the thickness of the bone.

Like the Stanford device for sinus surgery, Stredney’s simulator takes advantage of a commercially manufactured device created by a company called [SensAble Technologies](#). Instead of modifying the device by adding an endoscope, the researchers designed a virtual drill and suction tube, complete with realistic sounds and squirting virtual blood.

“Everyone gets nervous when something starts bleeding,” Stredney said. “It’s much better that residents learn how to handle those situations on a simulator than on us.”

The [temporal bone simulator](#) is designed for educational purposes, Stredney said, so it doesn’t integrate imaging data from real patients like the Stanford device. “There are lots of liability issues when you start to think patient-specific,” he said, “but that’s obviously where things need to go to be really useful.”

The next step for the Ohio State researchers is to test their device against traditional surgical training, to find out whether residents who practice on the virtual simulator actually perform better in the operating room than residents who don’t. Until they can prove that their device helps make better doctors, it may be hard to convince residency programs to invest in a simulator.



In orthopedic surgery, Cannon wants to go even further and make virtual training a part of the credentialing process for new surgeons. This year, he's leading a multi-institution research trial, sponsored by the American Academy of Orthopaedic Surgeons, to compare training on a virtual reality simulator with traditional training for a procedure called arthroscopy, which involves inserting a surgical camera into the knee.

"We're hoping to be able to train residents on a simulator in order to achieve a certain level of proficiency on a procedure before they ever go into the operating room," Cannon said.

To design the trial, the researchers took five senior orthopedic surgeons and measured their performance and speed on a virtual simulator. "Advanced surgeons can get in and out in 12 to 15 minutes and see everything," said Vic Spitzer of the University of Colorado, who led construction of the knee simulator. "When people first start, it takes 4 or 5 hours to get in and get out."

Residents in the trial must practice on the device until they demonstrate at least 83 percent of the skill level of the senior surgeons and can complete the procedure in a given period of time. Then their performance in the operating room will be recorded on video and compared to a group of residents who received only the traditional instruction on arthroscopy.

Six third-year UCSF residents have already finished the trial, and Cannon said it took them each about 13 to 15 hours of virtual training to reach the desired skill level. "Our hypothesis is that simulator-trained residents will outperform the other group," Cannon said, but they won't tally the final results until they have data from around 75 residents from institutions across the country.

Meanwhile, researchers like Blevins and Stredney are trying to improve the fidelity of touch-feedback and improve the graphic interfaces on their simulators. "We're a long, long way from having something that's indistinguishable from real surgery," Blevins said. "But that's our final goal."

#### See Also:

- [Report: Surgeons Perform Better After Playing Wii](#)
- [Slideshow: Pass the Virtual Scalpel, Nurse](#)
- [No More Crash-Test Surgery](#)
- [Dr. Robot, Report to the OR](#)

*Image 1: Temporal bone surgery simulator from the Ohio Supercomputer Center. Image 2: Stanford's virtual simulator for endoscopic sinus surgery. Image 3: A screenshot from the temporal bone surgery simulator. Image 4: Arthroscopy simulator from [Touch of Life Technologies](#), courtesy of Dil Cannon.*

*Video: A view inside the sinus cavity using Stanford's simulator/SensAble Technologies.*

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## Comments (8)

Posted by: tkerwin | 08/10/09 | 5:12 pm

You can view a video of the temporal bone surgery simulator discussed above at:  
[http://www.youtube.com/watch?v=Y\\_6finmrqao](http://www.youtube.com/watch?v=Y_6finmrqao)

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Posted by: matterwi | 08/10/09 | 5:57 pm

My university has been developing cataract and a number of virtual surgery with force feed back for years.  
<http://cs.millersville.edu/~webster/haptics/>

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Posted by: Hadley Leggett | 08/10/09 | 6:33 pm

@tkerwin: Thanks for the video link; I added it into the post.

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Posted by: WHITEHOUSE | 08/10/09 | 8:44 pm

..Talking about training new pilots and new doctors..What happen now in the LA is pretty not look good..The busiest airports in the west of the USAs..The older pilots, mechanics and airports workers are living in the trailers for \$60 a month..Nearby hotel has cost 10 times that, and they were saving money for the family, so they will live in the trailers, so they says on the news interviews..Air and med business went down like everybody else in these days..From terrorist-from high fuel cost-from lack of people global travel, because people has no income and saving their money for future economic downturn..The Lehman Brothers sisters and Bears Stearns and all others colossal royalty failure..

..In the medical training these doctors are the best in the business I ever see..They make the training look like \$300 million worth Hollywood movie..Bullets flying virtuality slow motion across from the crowd bus and exit from the real bus..All the 100 of guns man surround the bus from the angry mobs, who are fed up with greedy politicians, insurance companies..And doctors are take care of the gun shots wound people faces and bodies like the faces and bodies before they injured, as like in the movies..Only happen in the USA and Hollywood..

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Posted by: ebob | 08/11/09 | 12:15 am

The practice of medicine is a must, but must they always practice on us! Doctor, have mercy on me.

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Posted by: towerdefence | 08/11/09 | 2:51 am

that's good.

[tower defence](#)

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Posted by: VRMedic | 08/11/09 | 1:44 pm

This truly ground breaking work will lead us to logical next step of other alternative educational environments based on virtual reality. With Stredney's model as a blue print, this type of educational reality can be expanded to any of the sciences, arts, or any area in which technical skills are required. The idea of someone in Colombo, Shri Lanka learning Temporal Bone Dissection from a physician in Ohio is the future of education and job training on this planet. Take note true visionaries at work here!

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Posted by: remiverhoeven | 08/11/09 | 2:23 pm

Also, the Eindhoven University of Technology (Holland) together with the European Design Center is working on a combination of augmented reality and advanced dummies to have midwives practicing rare and difficult procedures.

<http://www.edc.nl/applied-research/patientsimulator/>

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