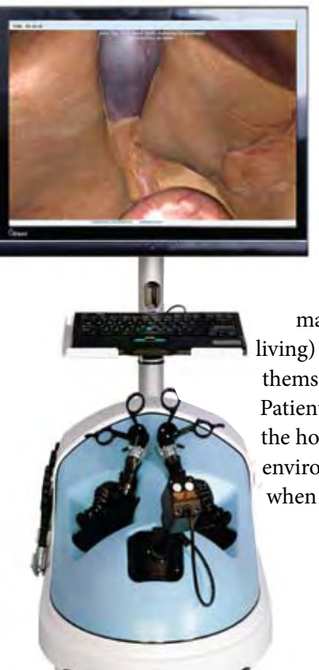
The End of See One, Do One, Teach One

Advances in virtual reality training will forever change the surgical tradition of "learning by random opportunity."

Throughout medical history, surgical training has essentially depended on a system that would have been familiar in the studio of a 15th century painter or the workshop of a furniture maker or millwright. Over a period of five or more years, the young physician was more or less apprenticed to a master surgeon, whom the apprentice would follow along behind in the hope that over time the master would impart everything he or she knew about surgery. At the end of that time, the young surgeon would be released out into the world as a budding master on his or her own. The process has long been codified in the phrase, "See one, do one, teach one."



The rapid changes in surgery over the past two decades, however, have begun to make that training model obsolete. Not so long ago, the apprentice had only traditional open surgery to master and was "resident" (literally living) at the hospital, able to present themselves whenever they were called. Patients spent days, even weeks, in the hospital. And the medical-legal environment was very different. Even when the model worked, it worked inconsistently — in any group of graduating chief residents, for a range of surgical procedures, one person in the group may have seen not a single example of the specific operation, another may have done five of them. But they all entered the world of surgical practice on the same day, and could theoretically be called upon, regardless of training, to perform that operation.

Today there is still open surgery to master, but now apprentices must also experience several types of minimally invasive surgery: laparoscopy, endoscopy, robotic surgery, NOTES (natural orifice transluminal endoscopic surgery) — the list grows each year. There are more types of procedures that require greater technical skill but are performed less frequently. New shift limits mean that surgical residents aren't always around the hospital, and when they are they cover many more patients, most of whom they don't know. And those patients spend less time admitted, and are much less willing to be used, in effect, as practice fields for apprentice surgeons. All of those factors are putting an eventual end to the tradition that OHSU assistant professor of surgery Donn Spight, M.D., calls "learning by random opportunity."

Spight, who specializes in minimally invasive surgery, trained that way himself.

"I trained in the classic environment — the attending and the chief resident would be doing a laparoscopic operation," he remembers, "and the attending might think of me and say, 'Hey, call Donn to the OR,' and upon my arrival he would say 'We're going to teach you to sew — right now.' Your heart starts pounding and your sphincter tone gets high, everyone's watching, and the attending says, 'Step up, you have eight

Surgical skills program director Donn Spight, M.D.

minutes.' And you've never even had your *hands* on the instruments before! Everything you touch bleeds, the whole field is moving with the patient's respiration, and if it's a *nice* attending he or she is just watching — but most of the time they're huffing and puffing and asking, 'Why can't you do this?! Just *do* it!' and you have no clear idea of what you're doing. That's really a counterproductive way to learn."

A way to learn that Spight is helping to change. He is the director of the surgical skills program in the Department of Surgery, and with various colleagues under the direction of department chair John Hunter, M.D., is developing a virtual reality simulation training center dubbed "VirtuOHSU." Spight's program brings a formal curriculum and approach to a range of skills training that includes laparoscopy, vascular, ultrasound, endoscopy, open surgery and an ethics-in-communications module. The commitment to this new program is such that the didactic portion of the surgical residency curriculum has been expanded by several hours each week.

"I've been charged with the task of putting together a formal surgical training program outside of the OR," says Spight, who graduated from the Northwestern University School of Medicine, followed by a surgical residency at University of Cincinnati and a minimally invasive surgery fellowship at OHSU. "We use a wide range of technical simulators, from low fidelity to high fidelity, as a way to more quickly and consistently gain mastery in a nonclinical environment. The lowest fidelity would be a simple box trainer for laparoscopy, with a camera and a couple ports for the instruments. It simulates the body cavity crudely, but it's very useful for teaching the manual dexterity required. In the open surgery skills lab we use synthetic tissue, in the vascular lab we work with prosthetic tissue. Moving up the fidelity scale we have a virtual reality laparoscopic simulator, which on a screen creates an environment in which to practice procedures. We also have an endoscopy simulator which allows us to perform in a virtual environment colonoscopy, endoscopy and bronchoscopy. The highest levels of fidelity require animal or cadaveric models. These are infrequently used due primarily to cost and ehtical concerns. The future of simulation is to develop tools and environments that can mimic everything cadavers can."

As the VirtuOHSU center expands, Spight hopes to include physicians from the community, nurses and allied health providers in the training mix.

What does that future look like? Spight foresees the day when virtual reality simulators reach the point where digital information from an MRI or CAT scan, the details of an actual patient, can be downloaded into the simulator and reconstructed in a three-dimensional environment where the procedure can be practiced.

"Let's suppose," Spight explains, "that you were scheduled to laparoscopically remove a liver tumor. You could load the patient's CAT scan into the simulator, recreate the environment and do the procedure as many times as you need to become comfortable with the anatomy and anything you may encounter when you do the actual operation."

Beyond that, the future of simulation training may well be an entire virtual hospital, with team training capabilities for everyone from EMTs to emergency medicine and ICU personnel. Imagine a virtual patient who is involved in a car crash 60 miles from our virtual hospital, triggering a training exercise in which first responders reach the patient — likely a sophisticated robotic mannequin — in the field, run through all their procedures. The patient is then transported to the ED, where physicians and nurses practice their procedures, the surgical trauma team takes part, then to the OR for a simulated abdominal exploration, perhaps, then to the ICU. Actors might play family members to bring in ethics and communication training. All in all, every member of the team receives training and experience in a controlled yet realistic environment.

"You could train and test at so many levels," Spight says, "providers, the hospital system itself, resource management — that's the holy grail of simulation, training multiple providers, specialties and disciplines at once."

That's several years down the road, but already the new model of "see one, train one, do one, teach one" raises question among some surgeons who received all their training — and their trials by fire — in the OR. Can a tactile sense of manipulating tissue really be learned on a simulator? Isn't the very real stress of performing on a living patient valuable in preparing a surgeon for the times when something goes wrong? Beyond the fact that the questions are somewhat moot because the old model of training just isn't feasible any longer (and the fact that some simulators already offer what is called haptic feedback, to train the user's sense of touch as would real tissue), Spight believes the advantages far outweigh any drawbacks.

"There are some things that will always have to be gained in the OR," he says, "and simulation can't recreate the level of stress that you can feel working on a real patient — but of course the goal for any surgeon is not to be under undue stress during a procedure! But consider that, for example, when a resident begins on the laparoscopy box trainer it may take him or her 10 to 14 minutes to tie one knot, if he or she can do it at all. And that is without the field moving as it would inside a living person. In the skills program we train to reach a standard of proficiency, which is 98 seconds. So if a procedure requires 10 knots, you can easily see where the benefits begin. As I tell my residents, using simulation we can move, with the junior residents, from teaching concepts in the OR to teaching techniques and tips. With the senior residents we can move from teaching techniques and tips to a greater cognitive understanding of the case itself. Simulation outside the OR allows us to change the teaching environment inside the OR to a much higher level of understanding."

And that higher level of understanding will serve patients and the profession more effectively than in the days of learning by random opportunity.

Donn Spight, M.D., is building a surgical training program that doesn't use the operating room.