Blended Approach

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Surgical simulation and training is crucial in helping surgeons develop and refine surgical skill. Now a variety of offerings allow for honing these skills before stepping into the OR.

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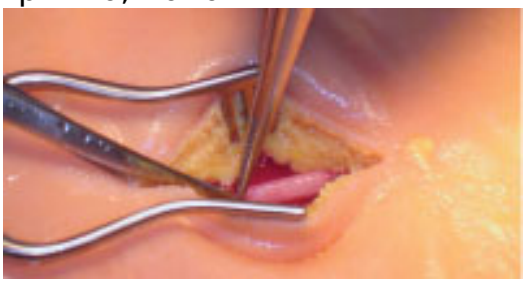

When James “Butch” Rosser, MD, FACS, professor of surgery at Morehouse School of Medicine, prepares for a case, he warms up with one of his favorite video games—Silent Scope or Super Monkey Ball.

This idea started as a result of Dr. Rosser and his team’s 2007 *Archives of Surgery* paper that showed surgeons with a history and demonstrated capability with video games perform surgical skills better than surgeons who have no experience with video games. This finding opened up a strong correlation between video games and advancing surgical skills.

In 2009, Dr. Rosser and his team followed up that information with a study that showed how surgeons warming up with these over-the-counter video games help decrease errors and increase efficiency.

Dr. Rosser’s research on video games is part of a view that a “blended” approach is needed in surgical simulation and training. As he explains, no single type of training platform is adequate to train surgeons. Further, due to the economic constraints associated with virtual reality simulators, cadavers and animal labs, not all surgeons have access to these high-end training tools. Thus, surgeons need a variety of surgical simulation and training platforms ranging in price and capability in order to prepare a surgeon for the OR and refine their surgical skills.

The Training Hierarchy

“We are really shadowing the aviation industry, which found out that you can decrease errors if you practice before you actually have to do it for real,” Dr. Rosser says. “For us, our art has always been about learning as you go, but with the 1999 publication of the book *To Err is Human: Building a Safer Health System*, we found out that there are over 100,000 deaths each year from medical errors.”

Moreover, Dr. Rosser says that 57 percent of those medical errors are surgical. "So, it stands to reason that if we can use simulation to practice before we actually do the operation on humans, and to sharpen our skills and keep them sharp with simulation rather than human beings, that it could decrease errors and also allow us to save more lives," Dr. Rosser explains.

However, the cost associated with some of the current simulation and training platforms can be high, and not all hospitals can afford the high-end simulators required for surgical training. At Morehouse, the surgical team uses a blend of simulation with various levels of cost-effectiveness and fidelity—or how close it resembles real life. Of course the closer the simulator gets to the real thing, the cost increases.

As Dr. Rosser explains, this mix of solutions provides surgeons access to all kinds of training platforms at different frequencies. Lower-end solutions can be used a lot, while higher-end solutions with true fidelity are used sparingly, but are still accessible. This hierarchy includes various tools:

Video games. In the 2007 research, Dr. Rosser and his team identified three out of 150 over-the-counter video games, without any modifications, that proved useful for surgical training:

- Star Wars Racer's Revenge
- Super Monkey Ball
- Silent Scope on practice mode (not single-shooter mode).

"Those games require non-dominant hand competence, visual-spatial skills, and tracking and targeting skills," Dr. Rosser explains. "These skills are also needed in minimally invasive surgery."

The common ground between the two? The use of screens for visualization. According to Dr. Rosser, the theory is that when a person plays video games, it opens up or matures certain pathways that can be recruited later for other tasks requiring similar skill sets. Minimally invasive surgery and video games share common ground as far as the development of skill sets.

"Now imagine, Xboxes and Playstations in surgical rooms where surgeons are going through five-minute training sessions that are actually helping them to warm up and

get ready to do surgery," Dr. Rosser says. "How cost-effective is that?"

Now Dr. Rosser's research is focused on scientifically identifying crossover points between video games and surgery. His goal is to one day design a video game that people would buy for fun, but that also enhances surgical skills.

Tabletop partial task trainers. At Morehouse, Dr. Rosser and his team use Fundamentals of Laparoscopic Surgery (FLS) and his own product, the Top Gun Laparoscopic Skills and Suturing program, as tabletop partial task trainers. These tools include simulated organs as surgeons use laparoscopic instruments to do partial tasks that are necessary in laparoscopic surgery, using a laparoscopic camera for visualization—just like in real surgery.

Virtual reality trainers. The team uses MIS simulators and LapSim simulators to simulate more complex cases and situations. As Dr. Rosser notes, these solutions add another level of complexity—and another level of expense—to the training.

Animal models. Sparingly, the institution uses cadaver animal models to develop skills.

"We have to have a blended solution because it's not episodic training that is important, it's continuous training," Dr. Rosser says. "If you're going to have continuous training, you can't use cadavers all the time. You can't use pigs all the time. You can't use virtual reality simulators all the time. You can't use partial trainers all the time. That's why we have been very aggressive in our research to find out what over-the-counter video games can serve a positive purpose in the whole training area."

Adding New Solutions

Along the lines of Dr. Rosser's "blended" approach, other physicians around the country are exploring new surgical training solutions. J. Ryan Williams, MD, a resident at the University of South Florida, is currently researching materials or equipment outside of the hospital that can be used to train surgical skills without having residents learn those skills on human patients.

Dr. Williams is looking at providing training solutions for situations residents may not experience much, if at all, during their residency. This includes circumstances like having to convert to and perform open procedures, or being ready if something goes wrong.

"Much of the surgical simulation has been virtual reality computerized trainers," Dr. Williams says. "What we are starting to realize is most residents are getting the opportunity to do a lot of MIS surgeries throughout their residency training. When they get into their practice, it's becoming a little bit harder for them to have completed some of the open procedures that were really common 30 years ago.

The most common thing that we associate with that is open cholecystectomies for gall bladder disease. Most residents do plenty of laparoscopic cholecystectomy, but then they don't really get the opportunity to do many open cholecystectomies. If they're lucky, they get to do one as part of another case."

To research new training mechanisms for this, Dr. Williams and his team have enlisted the help of SynDaver™ Labs, a Tampa-based company that manufactures synthetic human tissues, body parts and soon, whole bodies.

According to Dr. Christopher Sakezles, president and chief technology officer of SynDaver™ Labs, the company's products are much more than a "looks like" simulation of living human tissues. The company's design process begins with a battery of tests performed on both living animal and human tissues. Through a process of designed experimentation guided by previous experience, the company comes up with a series of candidate analog materials for each tissue in question—whether it be skeletal muscle or fascia or fat. Then the same battery of tests is performed on each candidate material on the same equipment and under the same conditions as the original target tissue. The end result is a synthetic tissue that mimics a target tissue.

"We actually validate mechanical and physical properties like tensile modulus, penetration resistance, abrasion resistance, coefficient of friction, electrical and thermal conductivity, and many other properties. When you perform that level of validation on the individual tissues and put them together, you end up with finished body parts that don't just look and feel like the real thing—they respond to stimulus in much the same way," Dr. Sakezles says. "It goes well beyond visual appearance into a realm where you can actually perform medical device tests or surgical procedures, and get results and experience that are similar to live animal studies and human clinical trials."

While the company is still in the early stages of providing surgical simulation solutions, they're starting simple with kits to practice with laser scalpels and electrocautery devices, placement of tourniquets and IV catheters, surgical cut-downs and suturing. The ultimate goal is to provide a complete cost-effective surgical training platform, Dr. Sakezles says.

For residents like Dr. Williams, he's finding SynDaver™ Labs' products can help train surgeons on imperfections by introducing pathologic disease into the tissue, or allowing trainees to perform open procedures.

"[Residents] can practice day in and day out on the perfect scenario, but when they get into the hospital, every patient is different and no patient is necessarily going to be a perfect scenario," Dr. Williams explains. "So by training them on imperfections, they're able to address similar imperfections when it comes time to do those procedures."

Further, Dr. Williams says that a lot of current simulators focus on procedural skills and developing muscle memory by practicing techniques over and over. However, surgeons also need to learn to couple that technique with teamwork and communication.

"We also need to teach being the team leader," Dr. Williams says. "Learning how to do the procedure while handling disaster scenarios and being the person that runs it

all while still performing the surgery, those individuals' communication skills are much better and their leadership skills are much better."

The goal would also be to make these tools cost-effective enough for frequent everyday use by surgical trainers and residents, Dr. Williams adds.

"[Residents] can keep going through these procedures until their fingers get so agile that they almost can do the surgery themselves from muscle memory," he says. "You can tie the knot. Your fingers know exactly how they need to do it, but at the same time, you're keeping your eye on the anatomy in the abdomen that you're concerned about or talking to the anesthesiologist about the blood loss."
Arguably, all training tools work to help surgeons learn and refine their skills before they step into the OR. Still, the questions remain about who pays for these tools, and how accessible they can be to all surgeons in helping them reach the ultimate goals of increasing efficiency, decreasing errors and saving lives by all means necessary.

Based on the connection between video games and surgery, Dr. Rosser authored the book "Playin' To Win: A Surgeon, Scientist and Parent Examines the Upside of Video Games." Check out www.playintowin.com *[1] for more information.*

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