

## Dr. Yang's surgical navigation device balances revolution with evolution

Pairing innovation with practicality is perhaps the defining characteristic of Dr. Yang's surgical navigation device. Conceived and developed by a Ryerson University research team led by **Victor Yang, MD, PhD, P.Eng, FRCSC**, a staff neurosurgeon at Sunnybrook Health Sciences Centre in Toronto, Ont., and senior scientist at the Sunnybrook Research Institute; the device resembles an unremarkable LED operating room (OR) light — a simplicity that belies its underlying sophistication.

### How the device works: Past and present imaging, matched at lightning speed

Dr. Yang's surgical navigation device uses refined optical information to present preoperative patient data as intraoperative data. In simpler terms, the device — while looking like an OR light — shines a special pattern onto the patient. This pattern is indistinguishable from ordinary light to the operating room team, but the machine sees an accurately-sized, three-dimensional surface of the patient's anatomy. During surgery, as the patient's skin is exposed, the machine matches the patient's current anatomy to his or her preoperative CT or MRI scans, thereby providing that information to the surgeon in real time.

"The system matches all of that imaging within milliseconds," said Dr. Yang, who is also an associate professor, Division of Neurosurgery, at the University of Toronto, and associate professor and Canada Research Chair (Tier II) in Bioengineering and Biophotonics in the Department of Electrical and Computer Engineering at Ryerson.

"It provides the relevant x-ray type 3-dimensional information that a surgeon needs to perform complex procedures, allowing him or her to see subsurface anatomy *in the present tense*."

### The case for 7D: Making technology meaningful, relevant and easy to use

Using Dr. Yang's concepts, the idea to commercialize this technology through 7D Surgical was born out of an apparent need to create a computer-aided surgical device that would be valuable for spinal surgeries. Studies have shown that computer-aided surgery makes good sense in terms of clinical outcomes and economics; nevertheless, the adoption rate of these technologies for spinal surgeries has been low. If the principle of the technology works, then there must be a problem with the design and the ease with which it can be implemented, Dr. Yang surmised.

"Many of the current computer-aided surgical devices came from innovations in the field of Neurosurgery. Once the basic 'highway' configuration was optimized for the brain,



Photo Credit: Doug Nicholson

companies added software and hardware to adapt it for spinal navigation — but spine surgery has a different workflow and geometry than cranial surgery.”

To accommodate for this, Dr. Yang and his team studied the differences between the two workflows in minute detail, exhausting case studies, personal observations and human catenary studies. Using machine vision, they verified the geometry and timed each element in the workflow with a stopwatch. These efforts confirmed the two values upon which the 7D Surgical concept will be built:

1. Surgeons are more likely to use new technology that can be quickly and easily integrated into their existing workflows.
2. Surgeons’ only interest is in knowing the real and present state of their surgeries, not patients’ “before” states.

“In medicine, we obviously want revolutionary changes because that’s good for patients; yet, we want things to be implemented in an evolutionary way. The ideal is small changes, on a daily basis, so when you add them all up it becomes a revolution for patient care. Sometimes too great a leap, in terms of technology, may not work out because it may be too far ahead of its time,” he said.



Photo Credit: Doug Nicholson

## The benefits of surgical navigation: For patients and the OR team

To-date, Dr. Yang’s prototype device has been piloted by five surgeons on 24 patients, as well as by a number of residents and fellows. This clinical trial process will continue for 120 patients, but already the team is seeing benefits in terms of precision, ease of use and time-saved.

Using the surgical navigation system, surgeons can see the position of their instruments, obstructions and surgical materials with incredible accuracy, which facilitates delicate surgical maneuvers. That precision, in turn, reduces the likelihood of patients requiring surgical revisions.

The device also eliminates the need for an intraoperative scan, which requires the use of a bulky machine that is difficult to bring into the OR and time-consuming to set-up; given the technology’s placement in the lighting system, no additional hardware is needed. Moreover, since surgeons are well-trained to keep the surgical area lit, the device has a relatively low impact on current workflows and is intuitive for surgeons to use, with little orientation.

The elimination of intraoperative x-rays (or CT) is also a big benefit to the OR team: nurses are pleased that they don’t have to wear lead vests, anesthetists are pleased with the shorter window between the administering of drugs and the start of surgery, and operating room managers are pleased with the decline in overall OR time.

“If you can do things faster and achieve the same level of accuracy, that’s also cost-effective,” said Dr. Yang.

### **The final word**

While the potential for this device to benefit patients is tangible (and Dr. Yang is hopeful that hospitals will invest in this technology once it is out of clinical trials) he cautions surgeons to avoid a false sense of security with this, or any other, innovation.

“As a surgeon, I recognize my own shortcomings; I understand that no surgeon is perfect. As an engineer, I also understand that no technology is perfect. So, as a surgeon-engineer, I am very sensitive to the high-stakes care that we provide to our patients and also the double-sided blade of technology. Even with a great tool, we still need to be humbly aware that technology is only as good as the surgeons using it.”

*Learn more about 7D Surgical from their website: [www.7dsurgical.com/news.html](http://www.7dsurgical.com/news.html)*

