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MEDICINE

New surgical tool improves outcomes for brain cancer patients

Leading engineers and brain cancer researchers in Montreal have teamed up to develop a unique cancer-detection tool that will improve the outcome of cancer patients undergoing brain cancer surgery – and that also has the potential to revolutionize the fight against all types of cancer.

One of the major problems surgeons face when performing surgery on patients suffering from brain cancer – particularly glioma, which makes up 80 per cent of primary brain cancers – is differentiating between healthy and diseased cells because both look virtually the same to the human eye, says Dr. Kevin Petrecca, chief of neurosurgery at The Neuro in Montreal and co-senior author of a study published on the new technique in Science Translational Medicine.

The difficulty of distinguishing between good cells and bad is less relevant when operating on other types of cancers because surgeons are free to remove at least a bit of healthy tissue without compromising the host. However, in brain surgery, removing healthy tissue can have catastrophic consequences, including irreversible brain damage. Surgeons tend to err on the side of caution and remove as little tissue as possible, but that often leads to cancer cells remaining behind, which is frustrating for surgeons and potentially fatal for patients.

"Even when using state-of-the-art techniques we never remove enough, and the cancer invariably recurs right at the edge of where we were working," says Dr. Petrecca.

The new hand-held Raman spectroscopy probe will be a game changer for surgeons like Dr. Petrecca because it will allow them to distinguish between cells that should stay and those that have to go, all in real-time on a laptop while they are performing surgery. The probe works by directing laser light onto cells and then analyzing the light coming back through a spectrometer, explains Dr. Frédéric Leblond, professor in engineering physics at Polytechnique Montréal, and co-senior author of the study. "The remitted light provides a spectroscopic signal that can be interpreted to provide specific information about the molecular makeup of the interrogated tissue with an accuracy rate of 92 per cent," he says.

Although the probe was developed to help detect cancer in the brain, Dr. Petrecca says it can also be used to track down and remove cancers throughout the human body. "We've tested this on other types of cancers and have yet to find a situation where it does not work," he says. The probe is also expected to revolutionize screening techniques, leading to earlier detection and ultimately better outcomes for patients developing or suffering from cancer.

"Raman has the capacity to detect cancer in all different types of tissues and in all different kinds of backgrounds, and to do it quickly," says Dr. Petrecca. "Once these things become affordable we will be able to screen for cancers and develop responsive therapies at an earlier stage, thereby reducing suffering, improving outcomes and extending lives."

The Raman probe is a good example of what happens when engineers and medical researchers collaborate on finding solutions. The difficulty doctors have differentiating healthy brain cells from those afflicted by cancer was not solved until the engineers were invited to examine the problem.

"This really is the perfect example of collaborative translational medicine at work," says Dr. Petrecca. "There's no way I could have done this on my own, and there's no way the engineers could have done it on their own, but put the two together and you get a super interaction."

Dr. Leblond adds that an increasing number of engineers are looking to medicine as a specialty. "It's a trend that's been emerging over the past decade," he says. "It's not just important but essential that engineering and medicine are fully integrated, and the Raman probe is a good example of what can happen when they are."

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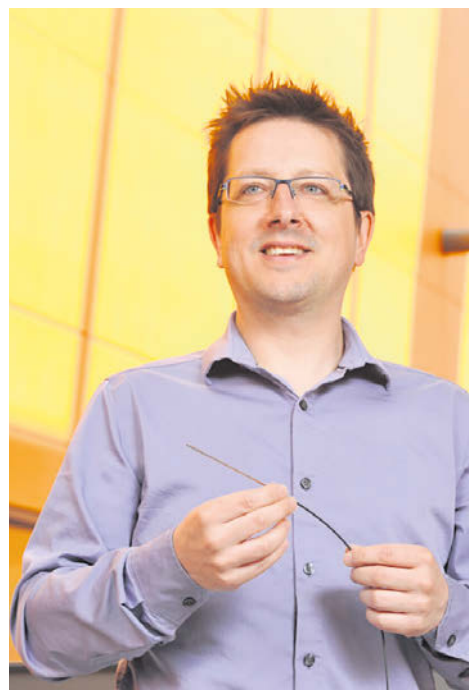
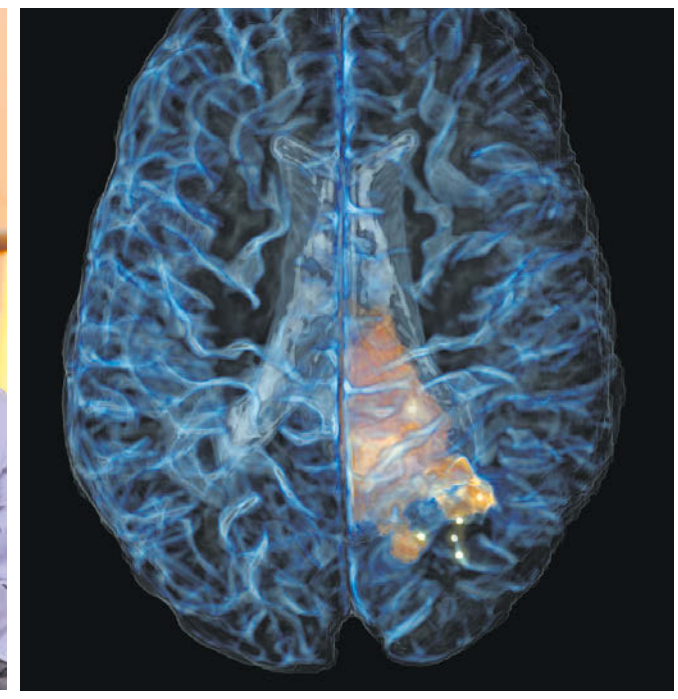
> is chief of neurosurgery at The Neuro in Montreal





Dr. Frédéric Leblond of Polytechnique Montréal has developed a spectroscopy probe that offers brain surgeons a revolutionary new tool to distinguish between cancerous and non-cancerous cells when conducting brain surgery. The bright points in the image of the brain scan are cancer cells detected using the probe; these cells are as far as one centimetre beyond what is detectable with MRI. Identifying and removing these residual cells will improve patient survival. SUPPLIED

Actua's new Codemakers program is one of its many outreach programs designed to expose children to hands-on experiences in technology, engineering and computer science. SUPPLIED

ENGAGEMENT

Transformational experiences spark youth interest in engineering careers

This spring, students at Nakasuk Elementary School in Iqaluit were taught basic coding skills, which they then used to record and remix traditional throat singing to create new music. It's a perfect example of the work done by Actua, a national non-profit that provides science and engineering enrichment opportunities to youth, with a focus on Aboriginals, girls, underprivileged youth and those living in remote and inner-city communities.

The pilot project in Iqaluit is part of Actua's new Codemakers program – launched this year with $1.5-million in support from Google – to get students engaged in computer engineering.

"Codemakers is about building those digital skills that are so vital for all science, technology, engineering and math fields," says Jennifer Flanagan, president and CEO of Actua. "What is so transformational is that the kids are not just playing with computers and consuming technology, they are becoming producers and innovators as they code their own applications and use software to create music."

Ms. Flanagan argues that it's critically important to offer opportunities like this to groups that have traditionally been underrepresented in science and engineering. She says some of the fastest-growing fields are underpinned by engineering and that we will only be able to reach our full innovation potential as a country when women, Aboriginals and other historically underrepresented groups participate more fully in engineering and technology professions.

Actua works to achieve these goals through Codemakers and other innovative initiatives that are community based and culturally relevant. Its National Aboriginal Outreach Program, for example, incorporates traditional Aboriginal knowledge into science and technology camps offered in Canada's Aboriginal communities.

Up to 1,000 undergraduates from engineering and science programs are hired by Actua's network member organizations to deliver the programs. These undergrads receive support and training to prepare them to offer hands-on workshops in thousands of schools in May and June before travelling to hundreds of remote communities – many of them Aboriginal – to run technology-based programs over the summer.

"Over 40 per cent of our own outreach instructors who travel throughout Nunavut, northern Ontario and Newfoundland and Labrador are Aboriginal," says Ms. Flanagan. "That's a big part of why our model and approach works so well. These students are so passionate about sharing their enthusiasm for science and engineering and being role models to younger students."

This year alone, Actua and its network members will reach 30,000 Aboriginal youth in 200 communities.

Ms. Flanagan emphasizes that improving representation of girls, Aboriginals and underrepresented youth in engineering and technology professions requires a multi-sectoral approach. "As a charity acting alone, Actua cannot effect change. But by working with universities and colleges, with our corporate partners like Google, Suncor and GE, and with all levels of government, we are creating a web of support and opening opportunities. That's what's needed to make sure kids are exposed to these areas at an early age, maintain their motivation in high school and are well supported through university and in their early career."

BY THE NUMBERS

73,035
Number of students enrolled in undergraduate engineering programs in Canada in 2013

18.9
Percentage of engineering undergraduate students who are women

14.7
Percentage of engineering undergraduate students who are from outside of Canada

12
Canada's rank out of 16 peer countries for the proportion of all students graduating in 2010 with a degree in science, math or engineering

Sources: Engineers Canada, Conference Board of Canada