DIRECT FROM THE SOURCE

Minimizing the negative effects of cancer treatment

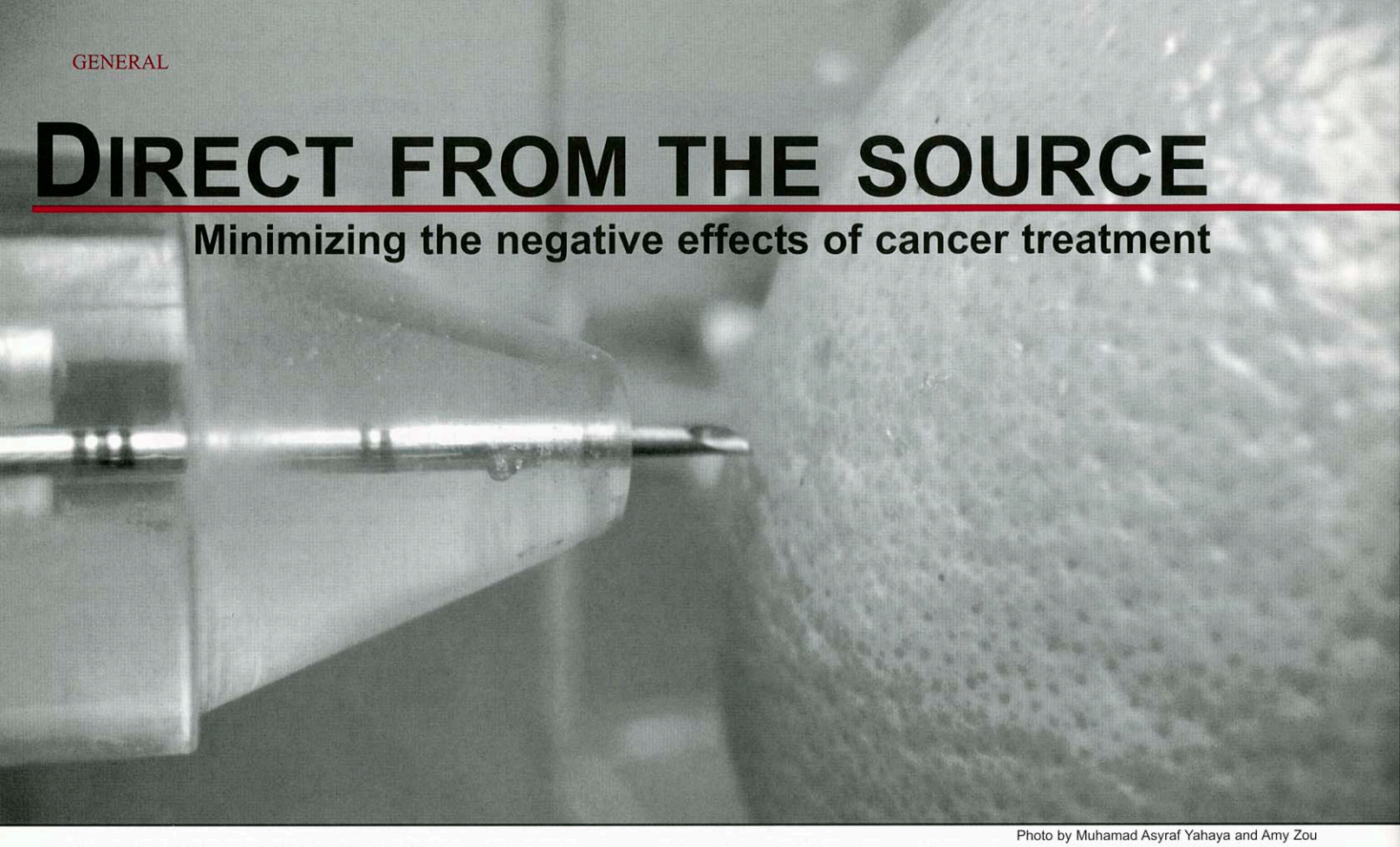

Photo by Muhamad Asyraf Yahaya and Amy Zou

By Alauna Hersch and Paul Kamenski

Albert Einstein once said, "The secret to creativity is knowing how to hide your sources." Little did he know that his thoughts on plagiarism would be the key to a newly optimized treatment for prostate cancer.

Douglass Henderson, professor of engineering physics, and Bruce Thomadsen, associate professor of medical physics, collaborated to come up with a new technique for treating prostate cancer. This treatment will more accurately and effectively radiate cancerous tissue and, in the process, minimize damage to surrounding healthy tissue. Doctors insert small radioactive sources into the prostate. These sources are shielded on specific sides to direct radiation toward cancerous regions. Their new three-component approach combines use of these sources with robotics and optimization software to decrease the deleterious effects of radiation on healthy tissue.

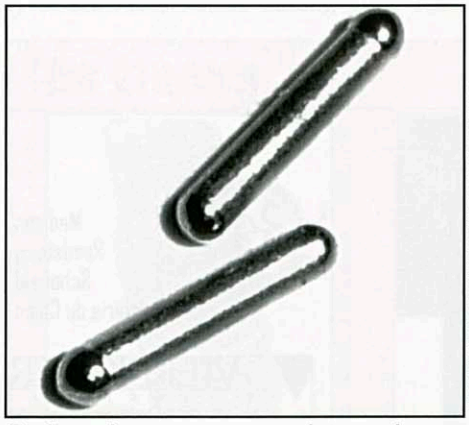

Photo by Muhamad Asyraf Yahaya & Amy Zou

Radioactive sources, no larger than a grain of rice, are injected into the prostate to treat cancerous tissue.

Prostate cancer is treated through the implantation of radioactive sources into the cancerous region of the prostate. Currently, doctors implant these radioactive sources by use of a sieve-like grid with aid from an ultrasonic view of the prostate. However, this grid limits source placement options.

"We couldn't put sources where we wanted them because there wasn't a hole there," Thomadsen says. This inaccuracy inevitably results in uneven dose distributions and the irradiation of healthy tissue.

Thomadsen began working on the robotics part of the invention in 1991, with the goal of increasing the accuracy of source placement. Robots are typically used because they are, as Thomadsen says, "very stable and precise." The robot is able to align the radioactive sources at different angles, which is not possible through the use of the grid template.

When Henderson entered the picture, he helped improve this treatment method. He came up with the idea of shielding the sources. A thin gold strip is inserted into the source in order to direct the radiation toward cancerous tissue and away from healthy tissue. This shielding significantly lowers radiation to protect sensitive areas. This allows doctors to, according to Thomadsen, "put sources in the prostate right next to the urethra or on the edge of the rectum." By strategically orienting the sources, doctors can direct the radiation toward cancerous areas. Their use of these directional sources, in addition to traditional non-shielded sources, will help increase treatment effectiveness.

Henderson also developed a new computer optimization process to further improve the precision and speed of the source placement. Before implantation, software initially maps out the calculated placement of all sources. However, due to inaccuracies in the placement procedure, sources do not always end up exactly where they are supposed to be. Older software did not adjust for this occurrence, but the new program recalculates where to put subsequent radioactive sources based on the actual location of previous sources. The speed of this program will allow patients to come for only one visit, compared

Photo by Muhamad Asyraf Yahaya and Amy Zou

Professor Bruce Thomadsen holds up radioactive sources for treating prostate cancer.

to the current two-day schedule--one for a pre-scan and one for the actual operation.

"[This procedure will] get the proper dose into the prostate very precisely while keeping the dose lower to the surrounding tissues," Thomadsen says. Using robotics in collaboration with the computer optimization program will, in turn, reduce the occurrence of complications and lead to more effective treatment.

If these inventions are employed, a typical procedure would run as follows: After an ultrasound is taken of the prostate, the physician runs the optimization software and transfers the information from the computer to the robot. The robot then implants the sources, either the regular or new shielded type. The entire procedure will take about two hours, including only a mere 20 minutes of implantation time.

This technique eventually could be used to combat cancers of other areas of the body. For example, by using shielded sources in the treatment of breast cancer, doctors can direct the radiation with more precision, delivering a lesser dose to the skin and lungs. The complexity of the head and neck make this procedure very attractive for treating cancers in those areas as well.

"The [directional] sources are good to better define where you're giving the dose and where you are not," Thomadsen says.

This faster and more precise way of treating prostate cancer may be available sooner than you think. Currently, the team is working on devising a way to anchor the directional sources so they do not rotate after implantation. Nevertheless, if things go as planned, animal tests will begin within the next year. With no other major delays, Thomadsen says, "in two years we will be ready to start some clinical trials with patients."

Thomadsen and Henderson's new three-component approach has the potential to enhance the effectiveness and accuracy of prostate cancer treatment. And – though the ideas were all their own – they have, in a sense, mastered the art of hiding their sources. WE

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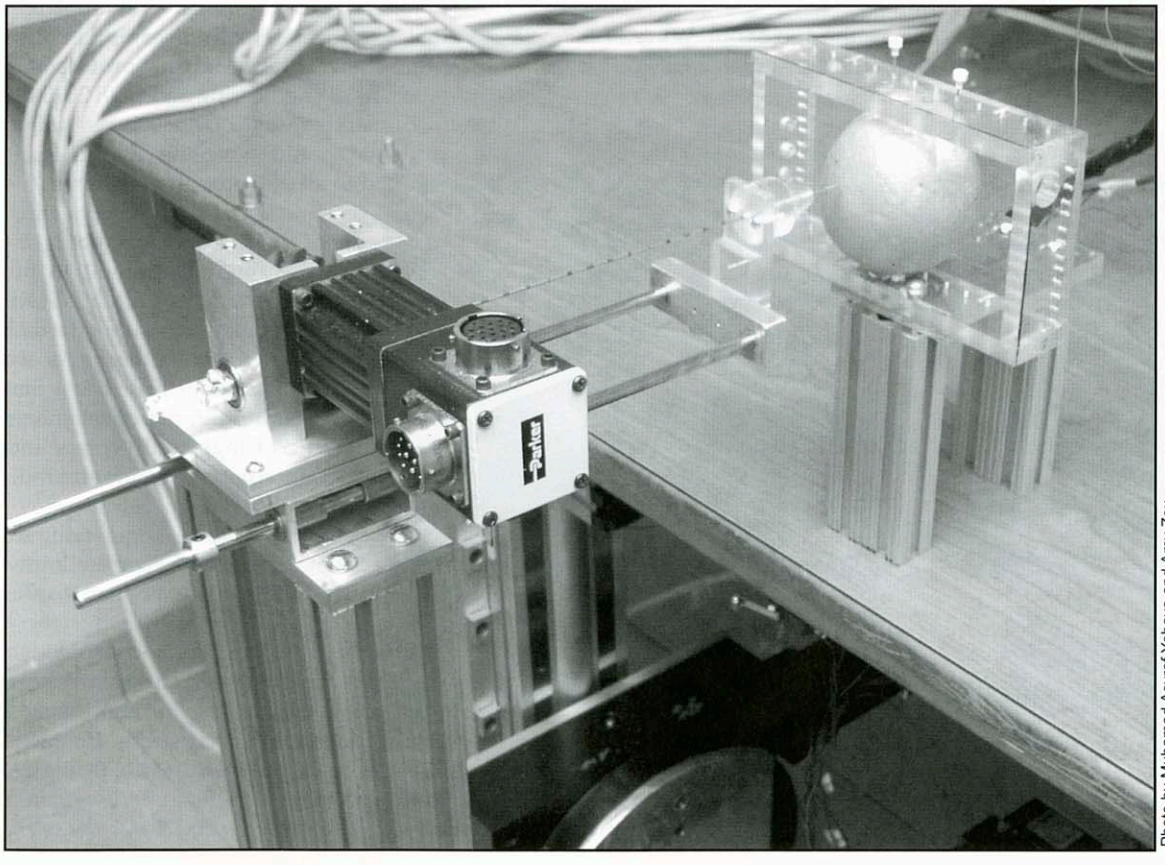
Paul Kamenski is a sophomore majoring in materials science and engineering, in which he plans to pursue a doctorate after graduation.

Alauna Hersch is a junior majoring in biology. She plans on attending medical school after completing her undergraduate degree.



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With data about the cancer's coordinates in the prostate, doctors can program the robot to insert the radioactive sources precisely into the tumor.