Photo courtesy Midwest Proton Radiotherapy Institute

Proton Proponents

NIU plans to bring proven, high-tech treatment for cancer to Chicago area

By Tom Parisi It often starts, once the initial shock has worn off, with a nervous search.

Such was the case for Stuart Cooper. Both his grandfather and father had succumbed to prostate cancer—his father at the age of just 68. And in November 2004, the 51-year-old Cooper found himself dealing with a diagnosis of the disease in its early stages.

"I was on a search to find out what treatment was best for me," says Cooper, who graduated with a law degree from Northern Illinois University in 1978 and now lives in New York.

Cooper knew surgery had its risks, as did traditional radiation, which can damage healthy tissue surrounding a tumor. After weeks of medical consultations, Internet searches and discussions with cancer survivors, he decided to travel across the country to undergo a form of radiation his doctors hadn't mentioned: proton therapy.

Cooper experienced minimal side effects from his treatments at Loma Linda University Medical Center in California. He says the treatment itself was painless. Best of all, he adds, he is cured.

Today, Cooper is a vocal advocate for what some doctors consider to be the most sophisticated form of radiation available. "There are two types of radiological oncologists," Cooper says. "Those who treat with protons—and those who wish they did."

Indeed, proton therapy is fast becoming the treatment option of choice for many patients who are managing "localized tumors," or those that have not spread to other sites in the body. Although thousands of patients have benefited from the treatment, it is unavailable in most states, including Illinois.

That will change soon, however, under an NIU plan to make state-of-the-art proton therapy available to cancer patients in the Chicago region by 2011.

NIU cancer center

NIU's proton therapy cancer treatment and research center is envisioned as a world-class facility.

The nonprofit center will eventually treat about 1,500 patients per year at a location in the DuPage National Technology Park in West Chicago. The park is contiguous to the northern boundary of Fermi National Accelerator Laboratory, which in the 1980s developed the first U.S.-based proton-therapy accelerator for the treatment of cancer at Loma Linda.

"Finding my way to Loma Linda and going through proton treatment has been a defining moment in my life," Cooper says. "To be cured, to talk about it to people, and then see that NIU, my alma mater, is planning a center, it has come full circle. It's a remarkable treatment, I can't say enough about it."

The university already has received $3.3 million in federal funding for planning but also is seeking state and federal funds to cover roughly one-third of the project's estimated $120 million cost. Once funding is secured, NIU will break ground in 2008 on a facility with four separate treatment rooms. The complex is expected to total about 100,000 square feet of space on 13 acres of tech-park land.

University officials are working to forge collaborations and affiliations with regional hospitals, medical research universities, community colleges and radiation oncology physicians.

"This project represents the kind of new public policy program that we need to develop in this country, one that brings together expertise of the region, our nation and the world," NIU President John Peters says.

"I have to say that of everything we've accomplished in recent years at NIU, I'm most proud of this initiative," Peters adds. "The power of this idea, the good that it will do, the direction it will take this region—this is a very exciting new venture in the life of NIU. It's also, first and foremost, something that meets a very real need in the lives of thousands of people in the region."

Above: Illustration of the proposed NIU research center. © BSA LifeStructures

Existing U.S. centers for proton therapy
Loma Linda University Medical Center, southern California
Midwest Proton Radiotherapy Institute, Indiana University
M.D. Anderson Cancer Center, Houston, Texas
The University of Florida Proton Therapy Institute
Francis H. Burr Proton Therapy Center at Massachusetts General Hospital

Proton therapy centers in development
Northern Illinois University proton therapy and cancer research center
Hampton University, Virginia
University of Pennsylvania Medical Center
Seattle Washington's Cancer Care Alliance
Oklahoma City

Source: National Association for Proton Therapy

Bringing technology home to Illinois

Today there are about two dozen clinical proton radiotherapy facilities worldwide and only five in the United States, where waiting lists for treatment are common.

The NIU center will deliver proton therapy for the treatment of pediatric, prostate and head/neck cancers, as well as for treatment of patients suffering from certain eye disorders. It will benefit from the intellectual power of neighboring Fermilab, in a real sense bringing home a technology that the laboratory helped champion.

Several of the laboratory's physicists and engineers are serving on the technical review committee for the project to help ensure that the technology is indeed state-of-the-art. "We have probably the world's top expertise in accelerators," Fermilab Director Pier Oddone said at the October 2006 press conference announcing the NIU plan.

"This in fact can be a leading facility in the world," he said. "We're committed to trying to make this happen. I'm very excited about the leadership that NIU is taking."

Inside the gantry—NIU alumnus Stuart Cooper (left) receives proton therapy treatment at Loma Linda University Medical Center in California. The gantry revolves 360 degrees around a patient so the proton beam can be delivered at any angle, precisely hitting the tumor. The patient feels nothing during the treatment.

Ken Bourkland, a senior engineering associate at Fermilab and a pilot who built his own aircraft, was treated for prostate cancer with proton therapy in 2005 at Loma Linda University Medical Center.

How proton therapy works

As a senior engineering associate for the past 37 years at Fermilab and a pilot who built his own aircraft, 66-year-old Ken Bourkland knows a thing or two about physics.

He was not among the Fermilab scientists who helped develop Loma Linda's proton-treatment system, but he includes himself in a growing legion of thankful patients. In 2005, he spent nine weeks at Loma Linda, undergoing treatments five days a week for prostate cancer.

When explaining how the treatment works, Bourkland likes to use the skyrocket analogy. Proton therapy is a form of radiation, but it utilizes proton beams instead of the photon (X-ray) and electron beams used in conventional radiation treatments.

Conventional radiation often irradiates healthy tissues in its path and surrounding the tumor site. Proton therapy more efficiently targets the tumor, leaving intact the surrounding healthy tissue and organs.

Think of a single skyrocket, Bourkland says. When it comes to a stop, it releases its energy, resulting in a burst of colors. A similar burst of energy occurs when the proton beam reaches the tumor.

The proton beam has a low entrance dose into the human body, a high dose designed to cover the entire tumor, and no exit dose exposure beyond the tumor. These unique characteristics make proton therapy a preferred treatment option in many cancers, including pediatric varieties, where traditional radiation can damage developing healthy tissue.

One-millimeter precision

"The NIU project will truly bring the most elegant of radiation therapy services to the Chicagoland area and the upper Midwest," says Dr. Allan Thornton, medical director of the Midwest Proton Radiotherapy Institute (MPRI) in Bloomington, Indiana. Thornton and George Coutrakon, director of the proton accelerator operations group at Loma Linda, are serving as chief consultants for the NIU project.

MPRI is treating a wide variety of cancers with proton therapy, including pediatric cancers requiring radiation and adult tumors of the brain, spinal chord, base of skull, prostate and rectum.

A brief history of proton therapy

Proton therapy isn't new, nor is it an experimental treatment. Using protons for cancer therapy was first proposed in 1946 by Robert R. Wilson, who later in life would become the founding director of Fermi National Accelerator Laboratory. Treatments on patients began on a limited scale in the 1950s both in the United States and in Europe.

"The NIU facility builds on more than 50 years of particle therapy expertise, originally initiated in Sweden and championed by Harvard University," says Dr. Allan Thornton of the Midwest Proton Radiotherapy Institute at Indiana University. Thornton is a consultant on the NIU proton therapy project.

New technologies developed or perfected in the late 1970s, such as magnetic resonance imaging, provide high resolution pictures of tumors, allowing doctors to take full advantage of the precision of proton therapy.

In the 1980s, Fermilab assisted in building and assembling the country's first hospital-based proton treatment system for Loma Linda University Medical Center in California. Its proton therapy center opened in 1990.

Today, proton radiation beams have been used to treat tens of thousands of people worldwide.

According to the National Association for Proton Therapy, most U.S. insurance providers cover proton therapy, including Medicare. The association notes that proton therapy costs more than conventional radiation, but generally less than surgery.

Learn More
For specific information on NIU's proton therapy plan, visit www.niu.edu/protontherapy; for information on other proton therapy centers in the United States, visit www.proton-therapy.org.

"To have a facility like this in the Chicago area is really potentially going to help thousands upon thousands of people."

— Greg Ford, proton therapy recipient

"Proton therapy derives its advantages from the inherent precision of the charged-particle beam, complemented by its unique ability to stop the beam at a predefined distance," Thornton says. "This stopping characteristic, known in the physics community as the Bragg peak, can be controlled to within one-millimeter precision and may also be shaped to the contour of the tumor."

Minimal side effects

Typically performed on an out-patient basis, proton therapy is noninvasive. In part because of its precision, patients experience minimal side effects, if any.

"There was no nausea whatsoever," Bourkland says, adding that each daily treatment would last only about 15 minutes, most of which was prep time. He was fitted with a molded body cast, or pod, to prevent movement during treatments.

With help from Loma Linda, Bourkland found an apartment to rent for the duration of his visit. He spent his free time sightseeing, meeting with a nutritionist and exercising at Loma Linda's fitness center. He even entertained relatives and friends on several occasions.

Bourkland says he is now cancer free.

While proton therapy is more expensive than conventional radiation, numerous insurance plans cover the treatment. Doctors and patients alike also point out that there are fewer post-treatment issues.

"The side effects are so much less that the patients oftentimes require less rehabilitation," Thornton says.

Educational opportunities

Like Loma Linda, NIU envisions a holistic approach to treatment, with student interns helping to provide patient services in such areas as counseling, nutrition, social work, clinical laboratory diagnostics, hospitality management, education of pediatric patients and speech, physical and occupational therapy.

Cherilyn Murer, vice chair of the NIU Board of Trustees and chair of the subcommittee to develop the university's proton therapy center, says a project of this magnitude "is of extraordinary value to the medical, scientific and academic communities of our region, and once again positions NIU to take a bold step in the advancement of academic excellence."

Students could develop specialized expertise in such areas as medical physics, medical engineering and nursing oncology. And researchers will examine the efficiency of combined treatments, working to maximize the potential of proton therapy.

"As a citizen of Illinois, I very much welcome and am excited about the health-care opportunities offered by this initiative," NIU Provost Raymond Alden says. "But as chief academic officer of NIU, I'm equally excited about the educational and research opportunities that this particular initiative allows.

"The center will afford us the opportunity to involve students from diverse fields, create new specialty concentrations and develop outreach programs for medical and health professionals who require advanced training," he adds.

'Feeling terrific'

Proton therapy definitely is high tech. The equipment needed for the NIU facility will include the accelerator, gantries, beam transport and delivery systems, patient positioners and imagers, alignment systems and computerized control systems.

At the Midwest Proton Radiotherapy Institute, Greg Ford was fitted with a body cast extending from under his arms to his knees and hoisted into position for each treatment with a robotic arm.

"It's the same robotic machinery used in the automobile industry," says Ford, who was diagnosed with a rare condition known as ependymoma at the age of 12. The disease causes tumors to grow in the brain or, as in Ford's case, the spine. As a preadolescent, he was treated with surgery and full-spinal radiation. The treatments made him terribly sick but wiped out the cancer.

At the age of 40, however, the tumors returned to the same area in his spine, prompting three more surgeries and chemotherapy over the course of seven years. "Chemotherapy didn't work for me—I've had some incredibly difficult treatments where I thought I was going to die," says Ford, a Wheaton, Illinois, father of three.

One operation left him walking with the aid of canes. He was advised that further surgery could leave him paralyzed. Ford says he had received a maximum dose of traditional radiation as a child, so that, too, was no longer an option. The tumors, meanwhile, continued to grow.

After his radiologist mentioned proton therapy and his wife, Rhonda, did some research, Ford turned to Dr. Thornton and proton therapy. He and Rhonda traveled to Bloomington, Indiana, in late 2005, when he began seven weeks of treatment at MPRI in an effort to stem the tumor growth.

For the Fords, the most difficult part of the experience was leaving behind their three teenagers.

"The first week I felt slightly nauseous, but after that I had no side effects whatsoever," Ford says. "My wife and I would exercise at the (local YMCA) for a minimum of an hour every day. We led a normal life.

"To have a facility like this in the Chicago area is really potentially going to help thousands upon thousands of people," he adds.

At last check, the proton therapy had successfully curtailed the tumor growth in Greg Ford's spine. "I am feeling terrific," he says. "I have not honestly felt this good for quite some time."

"Proton therapy derives its advantages from the inherent precision of the charged-particle beam, complemented by its unique ability to stop the beam at a predefined distance."

— Dr. Allan Thornton,
medical director, Midwest Proton Radiotherapy Institute, and consultant, NIU proton therapy project

Types of cancer treated with proton therapy

uveal melanoma (eye)
skull-base sarcomas (head)
meningiomas (brain)
paranasal sinus sarcinoma (sinus/nasal)
nasopharyngeal carcinoma (throat)
pediatric malignancy
paraspinal tumors (spinal)
prostate
craniopharyngioma (brain)
acoustic neuromas (ear)
large AVM (brain)
pituitary (brain)
metastases
gliomas (brain)

Other promising areas for treatment:
advanced gynecological disease
breast
lungs
rectal carcinoma

Proton center will complement NIU's neutron therapy clinic

The NIU proton therapy cancer treatment and research center will complement the university's existing program in neutron therapy.

In 2004, the university assumed management of the neutron therapy cancer treatment clinic at Fermi National Accelerator Laboratory. It is one of only three sites in the United States offering the neutron therapy treatment option to cancer patients.

Conventional radiation therapy includes photon (X-ray) and electron radiation, which is available at many clinics and hospitals. These beams are produced by electron accelerators or from radioactive sources such as cobalt.

Proton and neutron therapies are also types of radiation, but involve the delivery of discrete particles of irradiation. These proton and neutron beams are generated by large proton accelerators and then shaped to the dimensions of the patient's tumor.

The mechanisms of cell damage differ for the various types of irradiation. For photon and electron radiation, damage to cancer cells is done primarily by activated radicals produced from atomic interactions.

Proton irradiation is thought to derive effects from both free-radical intermediates (hydroxyl free radicals) acting on DNA helices and the direct release of collision energy upon the genetic material.

With neutron radiation, the damage is done primarily by nuclear interactions. Fermilab pioneered neutron therapy, used primarily to treat slowly growing, often inoperable tumors that do not respond to conventional radiation.

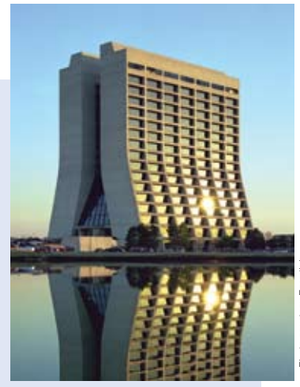

Photo courtesy Fermilab