

CT Simulation Advances Proton Beam Therapy by Helping Overcome Challenges with Tumor Motion



Making state-of-the-art proton therapy available to more cancer patients is the goal of ProCure Treatment Centers, Inc., headquartered in Bloomington, IN. The company partners with hospitals and radiation oncology practices to develop and operate proton therapy centers, using a standardized model that ProCure says may improve both the clinical practicality and cost effectiveness of this complex and expensive radiation treatment technique.



Proton therapy is a form of external beam radiation that uses non-electromagnetic ionizing radiation to treat solid tumors. Because it can be targeted more precisely at the tumor, the proton beam can deliver an increased dose of radiation with less damage to normal tissue than other forms of external beam radiation. Among the cancers treated with this technique are: prostate cancer, base of skull tumors, ocular melanoma, paranasal sinus tumors, non-small-cell lung cancer, and certain pediatric tumors.

A greater need for precision

“Precision in tumor imaging and treatment planning is critical to proton therapy,” says Niek Schreuder, MSc (med) DABR, ProCure’s senior vice president of medical physics and technology. “The whole process of proton therapy begins with imaging. It is much more dependent on excellent image quality and accurate density information when compared to other traditional radiation treatment techniques using electromagnetic ionizing radiation.”

For that and other reasons, ProCure selected the LightSpeed® RT¹⁶ wide bore CT simulator system from GE Healthcare to assist in proton therapy planning. The system was installed in February 2008 in ProCure’s Training and Development Center, the first facility in the world to provide proton therapy training using real life size equipment and simulators. In addition to training personnel for its partnership sites, the Center is also used for training radiation therapy students from the local state college.

Proton therapy works by harnessing the unique ability of protons to release the majority of their energy directly at the tumor site. Unlike photons, protons stop at a certain depth. “With protons, if you go too shallow, you’ll miss some of the target. If you go too deep, you may hit critical structures beyond the target,” explains Ben Harris, MS, DABR, ProCure’s director of medical physics at the Training and Development Center.

“The high resolution and tissue representation provided by the LightSpeed RT¹⁶ wide bore CT simulator images are critical factors in helping the radiation oncologist determine the exact treatment parameters to avoid those problems,” he says.

Overcoming the challenge of tumor motion with 4D imaging capabilities

“Accounting for tumor motion is another critical aspect of proton therapy planning,” says Schreuder. “A moving target for protons is a significant challenge because of the sensitivity of the beam path to density changes. A proton beam calibrated to deliver a high dose of radiation to a lung tumor when it reaches a certain depth in the lung, will release that load far deeper in the patient’s body if the tumor shifts out of the beam due to respiration motion.”

For that reason, the Center configured both the LightSpeed RT¹⁶ system and their Oncology Workstation with Advantage 4D® respiratory gating capabilities, GE’s exclusive tumor motion assessment software. “We have to know how the tumor is moving on a day-to-day basis. The only way to do that is through 4D analysis,” says Schreuder.

Improved workflow

Tumor motion assessment is one of many treatment planning tools available to the Center on their Oncology Workstation software platform, according to Lead Radiation Therapist John Smith, RTT. They also use AdvantageSim™ MD, GE Healthcare’s leading simulation and localization software.

“Advantage SimMD is a time saver and allows us to efficiently perform all of the front-end work in the treatment planning process up to dose calculation and plotting the isodose curves,” says Smith.

“Having such a productive workflow tool is critical in proton therapy,” says Schreuder. “The Oncology Workstation helps the Center use the proton therapy system more efficiently. We draw tumor volumes on the 4D workstation and send them to the planning system, which is then used to generate the treatment plan.”

The Center’s workflow is completely paperless, says Harris. The data from the LightSpeed RT¹⁶ and Advantage SimMD workstation feeds directly and seamlessly into the Center’s oncology RTPS and PACS environment. “There’s no paper involved because paper slows down the treatment process and is always at risk of getting lost,” he says. “Even the notes made by the radiation physicist on the characterization of the scan are captured electronically so they are always available wherever you are – even across the globe.”

Flexibility to position patients accurately

Proton therapy planning also requires greater precision in patient positioning, says Schreuder. The large bore of the 16-slice LightSpeed RT¹⁶ system helps in that regard. During treatment, the proton beam aperture is placed approximately 2 to 5 cm from the patient's skin, much closer than the 40 cm distance used in conventional radiation therapy. With the greater potential for interference between the equipment and the patient and the greater beam alignment sensitivity, the patient has to be imaged in the exact profile that will be used for treatment.

"We need the large bore scanner," Schreuder says, "because it provides more free space to position the patient so that the same form and shape can be reproduced accurately on the treatment bed a few days later."

A softer learning curve

Smith is in charge of developing and implementing the training protocols that will be used to train radiation therapists for all ProCure Proton Therapy Centers nationwide. He particularly appreciates the simplicity of operating the LightSpeed RT¹⁶ system. "It's a great machine. The menus are where you need them and the information you want to see most readily is always available on the main screen. It's very easy to teach people – the system softens the learning curve quite a bit."

The pathway to cutting edge cancer care

ProCure's first proton therapy center is being built in Oklahoma City, OK and is scheduled to open in 2009. ProCure has three additional proton therapy centers under development. At present, there are only five proton therapy facilities in the United States, treating about 5,000 patients each year. The company says that there are long waiting lists at these facilities and that upwards of 100,000 patients annually might benefit from the therapy if they had access to it.

"ProCure's mission is to expand the availability of proton therapy worldwide by reducing the time, cost, and effort necessary to create these facilities," says James Jarrett, vice-president of clinical partnerships. This is accomplished by providing a comprehensive solution for the design, construction, financing, staffing, training, and day-to-day operations of each center, including best-in-class diagnostic, treatment planning, facility management, and imaging integration systems and software.

"The development of a proton therapy center is a huge undertaking," says Jarrett. "People want advice and expertise on what works and what doesn't. We believe that working with companies like GE Healthcare can help us answer those questions and show our customers the pathway to cutting-edge cancer treatment."

He says that ProCure is especially interested in tapping into GE's transformational resources, like the Performance Solutions group, for assistance in optimizing facility design, workflow processes, technology utilization, and staff development. "The most important assets at any Center are the people who work there," says Jarrett. "We see Performance Solutions as providing tools and methodologies for continuous improvement."

Gaining insights into GE's vision for the future of imaging and radiation oncology will also be an advantage, says Jarrett. "It's always nice to run to where the ball is going to be," he says. "Knowing where things are heading will be helpful to ProCure going forward as we continue to develop innovations in proton therapy." ■

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