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IGRT in Europe: Coming on Fast



Image-guided radiation therapy (IGRT) has opened up new treatment possibilities as clinicians strive to boost doses to tumors while further minimizing damage to surrounding healthy tissues.

The ability to adjust treatments “real-time” based on tumor motion—caused by the patient’s breathing cycle, natural tumor movements, or variations in patient setup—has not only led to the wider introduction of conformal intensity-modulated radiotherapy (IMRT) treatments but has also given doctors the confidence to dynamically adapt their treatments based on far superior imaging.

To date, the majority of Varian's On-Board Imager® devices for IGRT have been sold as attachments on new linear accelerators rather than as upgrades to existing equipment. By April 2006, more than 200 On-Board Imager devices were installed or being installed at sites around the world. "For some time we had been predicting a rapid uptake of IGRT, and the response of hospitals around the world has borne that out," says Tim Guertin, president and CEO of Varian. "The fact that most centers are acquiring On-Board Imager devices with new equipment shows that IGRT is a major driver for clinics acquiring state-of-the-art treatment capabilities."

Another technology for using images to guide and adapt radiotherapy treatment is Varian's RPM™ respiratory gating system, which tracks and coordinates treatment delivery with patients' natural breathing patterns. This form of IGRT is most often used in the treatment of left-sided breast cancer, lung cancer, and other thoracic and abdominal tumors that are subject to respiratory motion.

In Europe, uptake has been similarly impressive. By March this year, 23 European clinics were equipped with—and clinically using—a total of 26 On-Board Imager devices for IGRT treatments. At Clinica Quadrantes in Lisbon, Portugal, Europe's first Trilogy™ medical linear accelerator was operated clinically for the first time in March, with Pedro Chinita, MD, and his team treating patients with prostate and neck tumors.

In this article, *Centerline* takes a closer look at two European sites that are using Varian's IGRT technology in innovative ways: At Clatterbridge Centre for Oncology in Liverpool, England, doctors are using the On-Board Imager's 3D cone-beam CT imaging capability for routine stereotactic neurosurgical treatments, while at Klinikum Dortmund in Germany, clinicians have extended their respiratory gating program to treat lung cancer patients.

Complex stereotactic neurosurgical treatments at Clatterbridge

At Clatterbridge in February 2006, a 40-year-old female patient with a solitary brain metastasis received a single session of radiosurgery on a Varian Clinac® linear accelerator equipped with an On-Board Imager device for establishing the exact location of the lesion. The On-Board Imager device enabled

doctors to pinpoint the location of the tumor using special cone-beam CT images and then to complete the treatment in less than an hour. Until now, this type of special treatment took up to four hours.

"The time-consuming nature of this sort of treatment has meant that we would normally have had to carry it out in the evening on specialized machines, after our routine work has been completed," says Angela Heaton, research radiographer at Clatterbridge. "It could take up to two hours to check calibrations before we could even begin treating, and the whole process could take several hours, which was inconvenient for both the patient and staff and made it a relatively difficult treatment."

She says stereotactic treatments could be further delayed when there was the need for neurosurgeons to attend and screw a head fixation device into the patient's skull in order to keep the device in place during transfer between imaging systems. Doctors say the new imaging treatment process makes it possible to avoid this uncomfortable and time-consuming step for most patients.

The patient selected for this pioneering treatment

had previous whole brain surgery for two brain metastases from an inoperable renal tumor in August last year, and although the primary tumor has not progressed, her long-term prognosis is still poor. A new 25-mm lesion had recently developed and was causing the onset of facial palsy and headaches from edema, which meant treating it could greatly improve her quality of life.

Using the Clinac accelerator's 120-leaf multileaf collimator to shape the beam, clinicians delivered a 15-Gy stereotactic radiosurgery treatment from eight angles, carefully checking the patient's head position between each treatment field. The entire treatment took less than an hour—about 20 minutes for patient positioning on the couch using a headframe, two minutes for cone-beam CT image acquisition, a further five minutes for online image matching, and about 20 minutes for treatment delivery.

"At present we could expect to do between 10 and 12 such treatments a year," says Brian Haylock, MD, the center's clinical director. "These patients have previously been treated out of hours because of time constraints, so this did not

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—Brian Haylock, MD, Clatterbridge Centre for Oncology, Liverpool, England



become routine. It's now important that we do everything we can to improve the efficiency as well as maintain treatment accuracy and improve patient comfort. That's why we want to move our stereotactic procedures across to the Varian machine, which also has the versatility to handle routine radiotherapy treatments when it is not being used for neurosurgical cases."

Respiratory gating extended to lung patients at Dortmund

Earlier this year, a 65-year-old German became one of the first lung cancer patients in Europe to be treated with radiation therapy that is delivered in timed bursts to take account of tumor movement caused by breathing. His respiratory-gated treatment was carried out at the Klinikum Cancer Center in Dortmund using a unique monitoring system that tracks and coordinates treatment delivery with patients' natural breathing patterns.

The RPM respiratory gating system made it possible for doctors to improve the treatment by boosting doses for the patient while sparing more of the healthy tissue surrounding his lung tumor. They were able to concentrate more dose on the tumor while reducing exposure of the surrounding healthy tissue by up to 22 percent.

"There's no doubt that this approach enables you to better protect normal tissue, increase patient comfort, and have fewer side effects," says Oliver Waletzko, MD, head of radiation oncology at Klinikum. "Because of this, we can safely boost doses to the tumor and have more effective treatments, all within a standard treatment time." Respiratory gating is used

regularly for left-sided breast cancer patients as a method of reducing the volume of the heart exposed to radiation, but it is much rarer for lung patients.

Unlike an active breath-hold technique—where the patient is forced to hold his or her breath during treatment—the RPM system offers faster and more comfortable treatments by making it possible to deliver bursts of radiation that coincide with a patient's natural breathing cycle. It is well suited for lung cancer patients who often have great difficulty in holding their breath, even for short periods. "Patients should just

lie down and breathe normally," says Waletzko. "Frankly, we want them to think about anything except breathing, so we don't coach them."

Ralf Rohn, MD, chief of the radiotherapy center at Klinikum, says, "There's no doubt that lung cancer patients can benefit from respiratory gating, particularly if their tumor is toward the base of the lung. Although we're in the early stages of treating lung patients with gating, the early signs are very positive."

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The 65-year-old retired electrical engineer from Dortmund, a lifelong nonsmoker, was selected for gated radiotherapy because of his overall condition and attitude. "He is very positive and in very good shape, which made him an ideal candidate for these treatments," says Andreas Block, PhD, head of medical physics.

Varian is the only company to offer respiratory gating that follows a patient's natural breathing pattern. The RPM system works by placing a marker box on the patient's torso and monitoring respiration using cameras positioned in the treatment room. Extremely accurate gating is enabled by proprietary design features on the Clinac linear accelerator along with Varian's high-speed digital control system, which can provide beam-on times of less than 100-ms bursts. •

ABOVE | Oliver Waletzko, MD, Andreas Block, PhD, and Ralf Rohn, MD, of the Klinikum Cancer Center in Dortmund, Germany. *Photo courtesy of the Klinikum Cancer Center.*