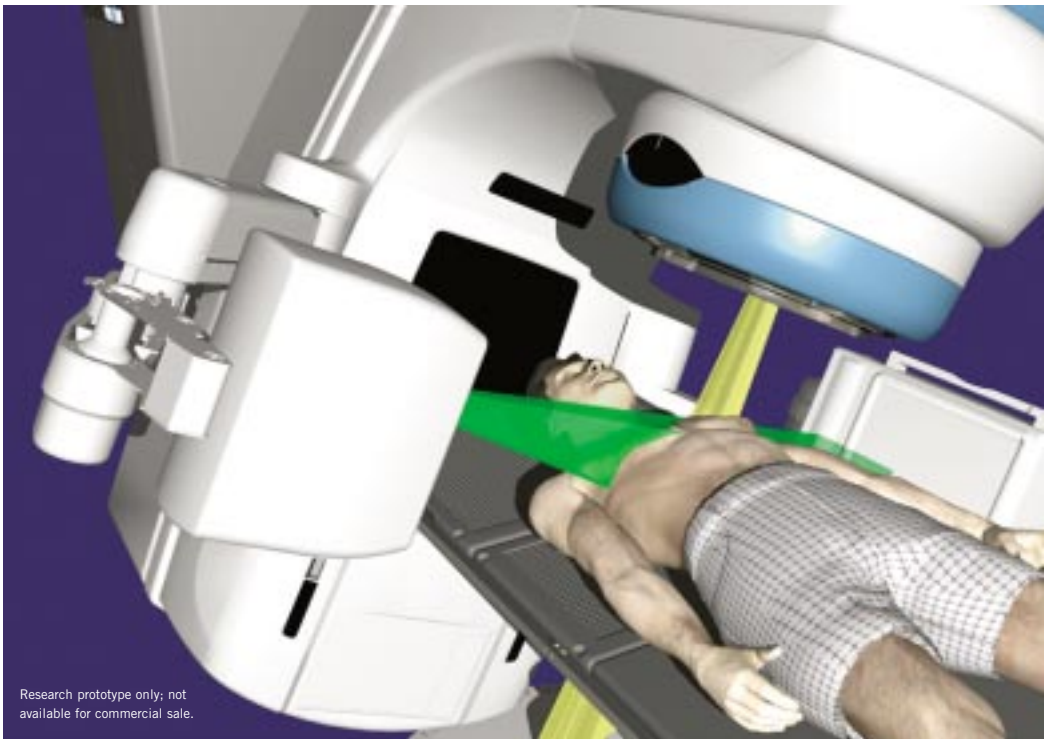
VIEWPOINT

The Radiation Oncology Department of the Future



An artist's rendition of a medical linear accelerator with an on-board imaging system consisting of an X-ray tube and an amorphous silicon flat-panel image detector on a pair of robotic arms. Clinicians envision using on-board imaging to verify tumor position and adjust for movement during treatment.

"Image-guided radiotherapy will make it possible to treat a broader range of cancer cases."

Timothy E. Guertin

With the advent of IMRT and other advanced forms of radiotherapy, imaging has moved to center stage in the field of radiation oncology. These new treatment approaches make it possible for doctors to plan and deliver radiation doses that are precisely tailored to each patient's anatomy and tumor. Consequently, clinicians need much more detailed information about the tumors being treated – information that we can get with the latest advances in imaging technology. Without images that can give doctors three-dimensional views of the tumor and the surrounding healthy tissues, these treatment approaches would not be possible.

DIAGNOSTIC IMAGING

Imaging plays a role at every step in the radiation oncology process, from earliest diagnosis to treatment verification. The radiation oncology department of the future will depend on diverse imaging modalities even more than it does today. Currently, for example, Computed Tomography (CT) and sometimes Magnetic Resonance (MR) imaging show the structure of a patient's internal anatomy and help the oncologist to determine the boundaries of a tumor. Very recently, however, doctors have begun to augment what they know about tumors using imaging techniques like Positron Emission Tomography (PET). PET imaging provides them with metabolic information about the location, size, and aggressiveness of the tumors they are treating. Better diagnostic imaging improves the utility of techniques like IMRT for delivering escalated doses of radiation to the most active parts of a tumor, as well as to any areas of early spread. In the future, we may see doctors using additional biological imaging techniques like Single Photon Emission Computer Tomography (SPECT) and Magnetic Resonance Spectroscopy (MRS) to learn even more about the nature of the tumors they are treating.

ON-BOARD IMAGING

Imaging is also increasingly playing a role in treatment delivery. Radiation oncologists use several forms of imaging to help them accurately target the tumor during treatment. Present-day tools include electronic portal imaging, a technology that uses the treatment beam to capture images of irradiated areas to make sure that beams are being delivered as planned. In the radiation oncology department of the future, medical linear accelerators will be equipped with on-board imaging — special X-ray systems that provide high-resolution images for verifying tumor position and tracking their motion during treatment. These new machines will use high-energy megavoltage beams to treat and kill tumors, and low-energy kilovoltage beams to acquire clear images that can be used to guide the treatment beam. In this scenario, doctors will need software that adjusts radiation therapy in a real-time response to tumor motion caused by a patient's breathing. This software will interpret the images coming from the on-board imaging system and coordinate the treatment delivery device so that it follows the tumor as it moves.

These developments, taken together, have the potential to simultaneously achieve unparalleled tumor control and spare the maximum amount of healthy tissue, opening the possibility of using higher doses within fewer treatment sessions. At Varian Medical Systems, we are actively developing an integrated suite of products that transform the radiation oncology department into an image-guided treatment center. Image-guided radiotherapy will offer us improved precision, and that will make it possible for radiation oncologists to treat a broader range of cancer cases. ■

By Timothy E. Guertin,
President, Oncology Systems

ILLUSTRATION BY BRIAN SPATOLA