

Groundbreaking MRI-guided radiotherapy enables UCLA physicians to target tumors in real time



UCLA radiation oncologists are now able to see and accurately target cancerous tumors and make immediate adjustments in treatment delivery as needed — all in real time — thanks to advanced MRI-guided radiation therapy. This technological advance addresses a longstanding challenge for radiation oncologists, enabling them to see the targeted tumor and the surrounding healthy tissue during treatment and ensure that the radiation beam stays within desired margins as tumors or organs move.

The UCLA Department of Radiation Oncology is currently home to the first-ever MRI-guided radiotherapy system — ViewRay™ — which incorporates magnetic resonance imaging (MRI) for high-resolution pre-treatment imaging as well as continuous imaging during radiation therapy for cancer patients. ViewRay was approved for clinical use in 2012 by the Food and Drug Administration.

Clinically preferred for imaging soft tissue

MRI is the clinically preferred method for imaging soft tissue because it can produce a clearer, more detailed view of internal organs than computed tomography (CT) without the radiation exposure associated with CT.

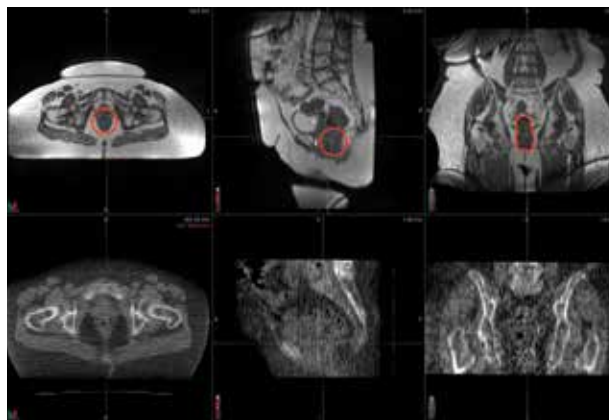
UCLA radiation oncologists explore MRI's capabilities

UCLA's Department of Radiation Oncology is one of the first three locations in the world for the ViewRay MRI-guided radiotherapy system, and the first in the Western United States. "The ability to image in real time with high-quality MRI during therapy is a game-changer in all respects," says Percy Lee, MD, associate professor of radiation oncology and clinical lead for the UCLA ViewRay program.

Department faculty plan to study how much some tumors — pancreatic cancer tumors, for example — move during treatment. This previously unavailable information can aid in developing strategies to escalate doses to the tumor while protecting neighboring healthy tissue from unnecessary radiation exposure.

"We're excited to demonstrate how real-time MRI-guided radiation can change the paradigm of how radiation therapy is delivered, with an eye toward benefiting our patients," Dr. Lee says.

In certain areas of the body, such as the abdomen, pelvis and breast, MRI allows physicians to more easily differentiate a tumor or tumor bed from healthy tissue, which can be difficult to differentiate on CT. For example, MRI-guided radiation therapy is superior to CT-guided therapy in differentiating lumpectomy cavities after surgery for breast cancer. The clearer visualization potentially allows for more precise therapy by reducing treatment margins and limiting radiation-induced tissue scarring.



MRI achieves superior soft-tissue contrast (top row), which clearly distinguishes tumor from normal organs such as the rectum and bladder. The image quality is significantly inferior on the cone beam CT (bottom row), which is commonly used in current clinical practice.

Tumor movement complicates radiation delivery

Real-time MRI imaging is especially useful for mobile tumors, which often change position in unpredictable ways. This movement occurs for a number of reasons, including the patient's respiration, heartbeat and muscle contractions. For example, a lung tumor can move an inch or more every few seconds as the patient breathes. Tumor movement can also be due to weight changes or the tumor's response to other treatments. Cancers expected to benefit from non-stop MRI imaging include lung, prostate, bladder and pancreas, along with cancers of the head and neck and central nervous system.

During treatment, ViewRay's integrated MRI-guided radiotherapy system captures a steady stream of soft-tissue images in real time and compares them to the planned treatment margins. If the tumor strays outside prescribed margins, the machine can turn the beam off until the tumor returns to its prescribed location.

Real-time adaptive and personalized radiation therapy

Current practice allows radiation oncologists to design treatment plans based on images taken days or weeks before the treatment date. If doctors suspect tumor movement from weight loss or other reasons, redesigning a plan can take several days. ViewRay's cutting-edge software allows UCLA radiation oncologists to adapt radiation in real time when necessary by creating a customized "plan-of-the-day" for each patient. In doing so, radiation that otherwise would have hit healthy tissue is redirected to hone in on malignant tissue, increasing the probability of exact delivery and improving outcomes.

MRI-guided radiation therapy expands the personalized treatment options available at UCLA and supports all available advanced and traditional radiation delivery techniques, including image-guided radiation therapy, intensity-modulated radiation therapy (IMRT), stereotactic radiosurgery and 3D conformal therapy.

Participating Physicians

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Assistant Professor of Radiation Oncology

Head and Neck:

Allen Chen, MD

Associate Professor of Radiation Oncology

Breast:

Susan McCloskey, MD

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Thoracic/Gastrointestinal:

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