Lung Radiosurgery

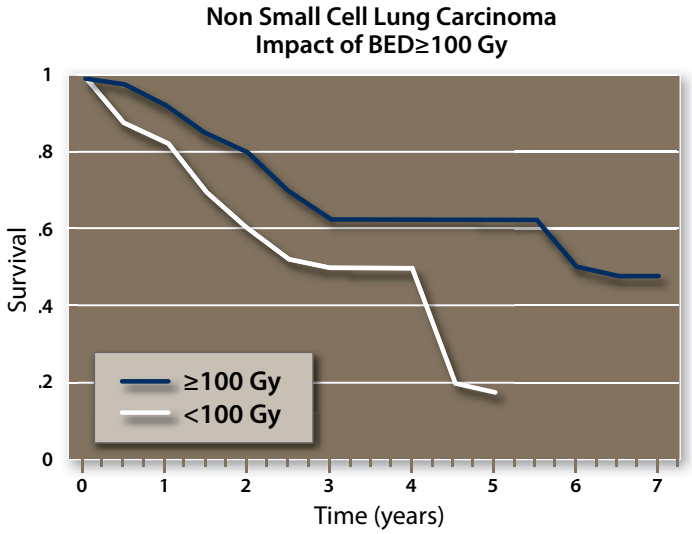
Precisely delivering ablative radiation to lung tumors while maximizing healthy tissue preservation

Lung cancer is the leading cause of cancer death in the United States.[1] While surgery is often considered the gold standard of treatment, its application is frequently limited by the patient's health and the stage and location of the tumor. A common non-surgical alternative for medically inoperable patients includes external beam radiotherapy, yet poor outcomes and high complication rates have precluded widespread use.[2] Supported by compelling scientific evidence, hypofractionated high-dose radiosurgery is emerging as a ground-breaking treatment modality – showing evidence of improved tumor control and patient survival when compared to conventional radiotherapy.[3]

Safely delivering lung radiosurgery presents considerable challenges given continuous respiratory-induced motion and significant surrounding healthy tissue. As a proven solution for treating medically inoperable lung cancer patients and those seeking an alternative to surgery, the CyberKnife® Robotic Radiosurgery System stands alone in addressing these challenges – setting new standards for accuracy, conformality, and respiratory motion tracking.[4,5]

Improved Tumor Control and Survival

Scientific evidence has demonstrated a direct relationship between survival and efficacy with radiosurgical dose escalations of greater than 100 Gy BED (see graph).[3] However, dose escalation for treating lung tumors has historically been limited by the destruction of normal tissue resulting from the large treatment margins commonplace with conventional, gantry based radiation therapy systems.



Unparalleled Healthy Tissue Preservation

Unlike the respiratory gating and breath-holding techniques of gantry systems, the CyberKnife System delivers tightly contoured beams that move precisely with tumor motion throughout the respiratory cycle. Integrating the Synchrony® Respiratory Tracking System, margins are limited to only that which are clinically relevant, dramatically decreasing the targeting and set-up margins typical with other respiratory compensation techniques. And with the 4D treatment planning capabilities of the CyberKnife System, tumor and surrounding structure motion and deformation are accounted for throughout the entire breathing cycle. Ultimately, the combination of these capabilities helps to ensure prescribed doses are limited to the intended target while maximizing healthy tissue preservation.

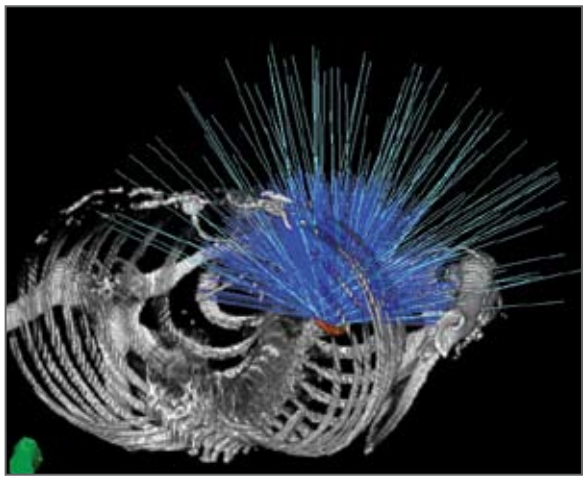


Image courtesy of Georgetown University Hospital

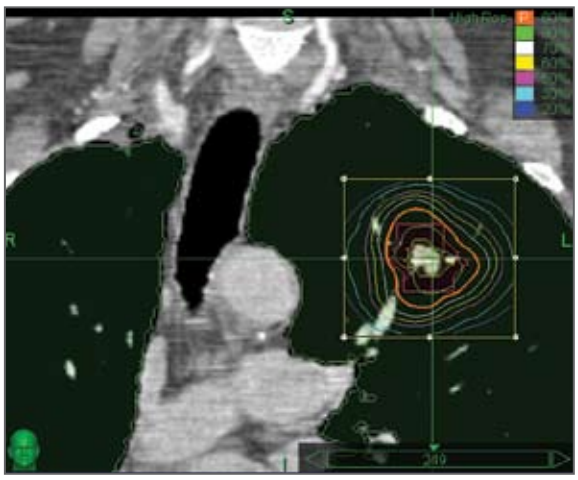


Image courtesy of Georgetown University Hospital

Where conventional gantry-based imaging systems such as IGRT and cone-beam CT provide image guidance for pre-treatment set-up, target movements during the treatment remain unrecognized with these technologies. Using advanced robotic technology, the CyberKnife® is the only system to utilize continual image guidance to automatically track, detect, and correct for target movements throughout the treatment. This intra-fraction image guidance capability unique to the CyberKnife System has proven to deliver an unprecedented 0.7 mm targeting accuracy when treating targets that move with respiration.[6]

Completely Non-Invasive Capabilities

Without the need for external frames or implanted fiducials the CyberKnife System is the only system to directly track lung tumors with radiosurgical accuracy.[7] Using sophisticated image processing and registration, tumors can be tracked non-invasively – eliminating the risks associated with fiducial implantation while expediting the patient's time to treatment.

Unrivaled Dose Sculpting

For more than 30 years, technical research and clinical studies have demonstrated that a large array of uniquely angled beams enhances the ability to precisely sculpt delivered dose to the target while reducing the risks of surrounding tissue dose toxicity. Unconstrained by the clockwise / counter-clockwise gantry rotations of conventional radiation therapy equipment, the robotic mobility of the CyberKnife System extends these proven benefits by delivering diverse non-coplanar treatments routinely in daily clinical practice. Using sophisticated Monte Carlo dose calculations, a typical CyberKnife System treatment includes more than 100 uniquely angled, highly focused beams per fraction – unlike the 7 to 9 beam plans commonplace with conventional IMRT treatment delivery.

Proven Capabilites - Proven Resullts

The CyberKnife System is now recognized as the premier solution for safe and effective lung radiosurgery delivery. With a large body of academic support, the CyberKnife System has now treated more than 50,000 patients and been installed as the radiosurgery system of choice by more than 140 institutions globally – including many of the most prestigious cancer centers in the world.

"Treating small moving targets reliably with tight CTV margins requires real-time image verification throughout the respiratory cycle. The CyberKnife has perfected this capability."

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References:

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4. Pennathur, A., Luketich, J. D., Burton, S., et al. Stereotactic radiosurgery for the treatment of lung neoplasm: initial experience. Ann.Thorac.Surg, 83[5], 1820-1824. 2007.
5. Seppenwoolde, Y., Berbeco, R. I., Nishioka, S., et al. Accuracy of tumor motion compensation algorithm from a robotic respiratory tracking system: a simulation study. Med.Phys., 34[7], 2774-2784. 2007.
6. Dieterich S, Taylor D, Chuang C, et al. The CyberKnife Synchrony Respiratory Tracking System: Evaluation of Systematic Targeting Uncertainty. Synchrony® Respiratory Tracking System clinical accuracy specification of 1.5 mm for moving targets.
7. Limited to laterally located lung tumors greater than 1.5 cm in diameter. Centrally located tumors and those smaller than 1.5 cm may require fiducial implantation. Xsight™ Lung Tracking System clinical accuracy specification of 1.5 mm for moving targets.

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