

## RIGHT LUNG METASTATIC SQUAMOUS CELL CARCINOMA



### Georgetown University Hospital CyberKnife® Team:

Brian T. Collins, M.D. <sup>1</sup>	1. Radiation Medicine
Eric D. Anderson, M.D. <sup>2</sup>	2. Pulmonary, Critical Care, and Sleep Medicine
M. Blair Marshall, M.D. <sup>3</sup>	3. Thoracic Surgery
Marc Margolis, M.D. <sup>3</sup>	4. Radiology
Carlos Jamis-Dow, M.D. <sup>4</sup>	5. Hematology and Oncology
Mike Lundsten, M.S., DABR <sup>1</sup>	
Sonja Dieterich, Ph.D. <sup>1</sup>	
Don McRae, Ph.D. <sup>1</sup>	
Shakun Malik, M.D. <sup>5</sup>	

CyberKnife Center: Georgetown University Hospital  
Georgetown University Medical Center  
Washington, DC

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### DEMOGRAPHICS

**Sex:** Male  
**Age:** 53 years  
**Histology:** Squamous Cell Carcinoma

### CLINICAL HISTORY

**Referred by:** Multidisciplinary Thoracic Oncology Team  
**Previous Treatment:** Surgery, Conventional Radiation Therapy and Chemotherapy

### Case History

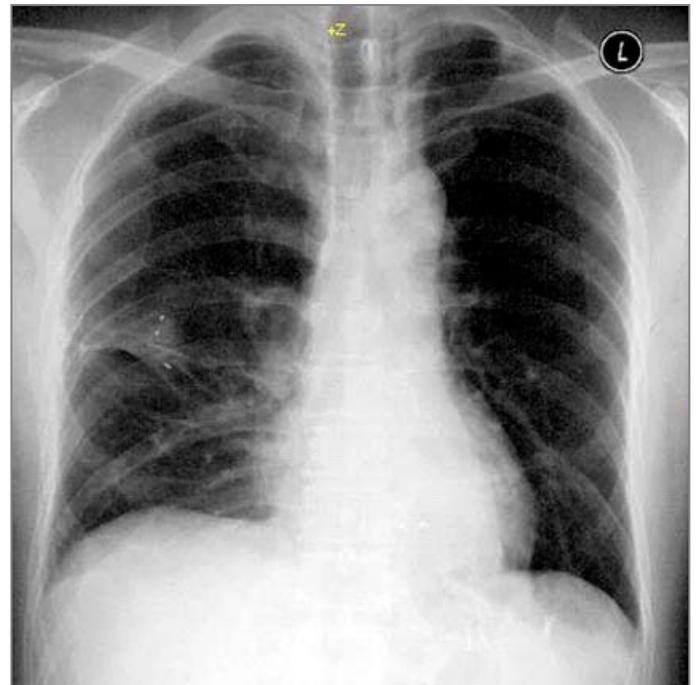
This case study reports on the first lung cancer patient treated at the Georgetown University Hospital using the Synchrony® Respiratory Motion Tracking System. This 53-year-old male patient had a solitary metastasis in the upper lobe of the right lung, of maximum dimension 3 cm and volume 11 cc. The primary disease was an esophageal squamous cell carcinoma which was treated with conventional chemoradiation and surgery. A subsequent nodule in the right lung was treated with a lobectomy of the right middle lobe. The patient refused surgery for the second lung metastasis, and following evaluation by the Multidisciplinary Thoracic Oncology Team was sent for treatment with the CyberKnife® System.

### CyberKnife Treatment Rationale

Radical surgery provides an effective standard therapy for early stage non-small cell lung cancer (NSCLC), but medical suitability for surgery and postoperative morbidity are significant problems. Traditional radiation therapy has met with limited success, as evidenced by poor local control and significant pulmonary toxicity. Stereotactic radiosurgery has recently been shown to offer promising results in these cases,<sup>1</sup> and previous application of the CyberKnife System to this treatment has been reported.<sup>2,3</sup>



Pre-treatment CT scan, showing the 3-cm right lung lesion with fiducial markers in place.



Pre-treatment AP radiograph showing the lesion and implanted fiducial markers.

**TREATMENT DETAILS**

**Tumor Volume:** 11 cc  
**Imaging Technique(s):** CT  
**Rx Dose & Isodose:** 45 Gy to 85%  
**Conformality Index:** 1.39  
**Number of Beams:** 138

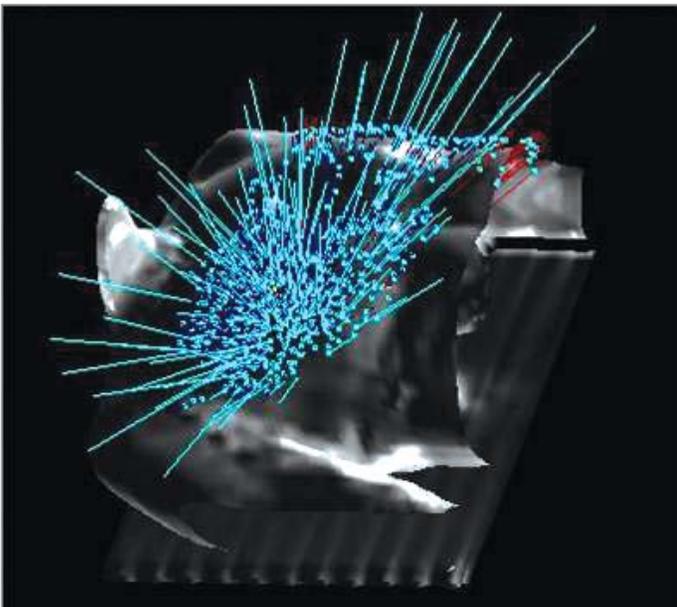
**Fractions / Treatment Time:** 3 / 90 minutes per fraction  
**Path Template:** 900\_1000 body  
**Tracking Method:** 6D fiducial tracking  
**Collimator(s):** 25 mm

**Planning Process and Goals**

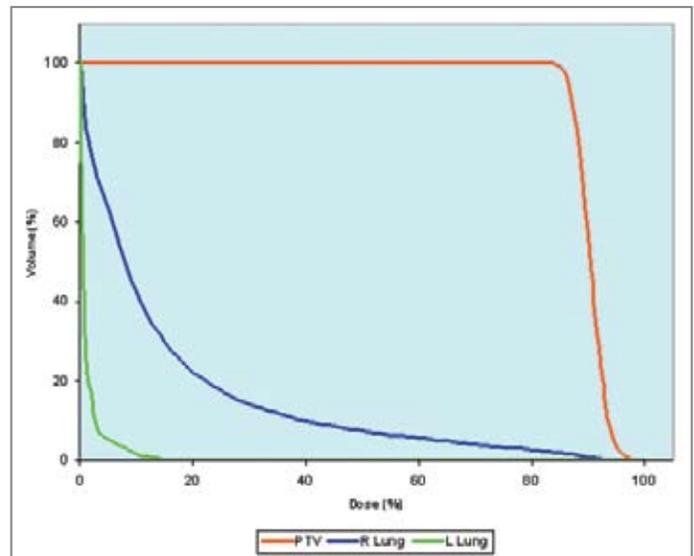
Three gold fiducials were placed within the tumor under CT guidance during an outpatient procedure without complication. Two weeks later a treatment planning CT scan was performed using a manual breath-hold technique. The patient was positioned supine with a vacuum-formed custom immobilization device. A treatment plan was developed to conformally cover a planning target volume (PTV) which included the gross tumor volume plus a 5-mm margin for potential clinical and technical uncertainty. The plan was generated using inverse planning and resulted in 138 treatment beams. A dose of 3 x 15 Gy was prescribed to the 85% isodose line, and delivered over one week.

**Treatment Delivery**

The patient was treated using the CyberKnife® System with the Synchrony® Respiratory Tracking System. The patient breathed normally during treatment and the tumor movement was compensated for in real-time by motion of the CyberKnife System. This compensation is based on the correlation between continuously monitored surface markers, and X-ray images of the tumor acquired between each treatment beam, which enables dynamic stereotactic radiosurgery to be performed. Each treatment, including set-up time, lasted about 90 minutes, and was performed as an outpatient procedure.



The 138-beam treatment plan – showing non-coplanar and non-isocentric geometry.



Dose-Volume Histogram, showing uniform coverage of the PTV with sparing of lung tissue.

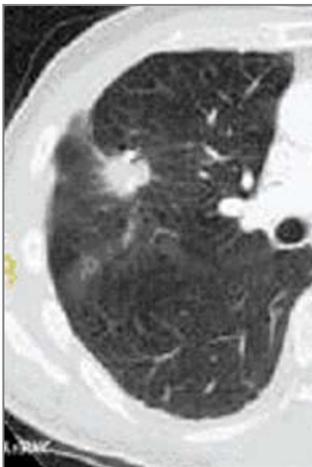
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### Outcome and Follow-Up

Follow-up radiographs were acquired at one and four weeks post-treatment, and CT scans at one, two and five months post-treatment. No treatment complications were evident on initial imaging or have been apparent in examination of the patient. At one month follow-up the tumor volume was seen to have reduced and this reduction improved further at two months. At five months the tumor volume continues to reduce, but some fibrosis has become apparent in the treated region. This is not causing the patient any detrimental effects and is therefore not felt to be clinically relevant.

### Conclusion and CyberKnife® Advantages

The CyberKnife® System has delivered a painless, complication-free treatment which has resulted in partial tumor response and has achieved local control at five months post-treatment.



1 month follow-up.



2 month follow-up.



5 month follow-up.

### GEORGETOWN UNIVERSITY HOSPITAL ([www.georgetownuniversityhospital.org](http://www.georgetownuniversityhospital.org))

Georgetown University Hospital's (GUH) CyberKnife® Robotic Radiosurgery System, installed in 2002, was the first system on the East Coast. The Synchrony® Respiratory Tracking System was added in 2004 and Xsight™ Spine Tracking in 2006. The CyberKnife System allows GUH physicians to provide a targeted, minimally invasive alternative to open surgery and a treatment option for certain tumors that are otherwise untreatable. GUH physicians and the Radiation Oncology Department have created a multi-disciplinary approach to provide their patients with the most comprehensive diagnosis and treatment possible. Over 400 patients were treated in 2006, with a clinical workload of 45% intracranial, 20% spine and 35% extracranial non-CNS. GUH physicians recently treated their 1500th patient with the CyberKnife System.

### References

1. Timmerman R, Papiez L, McGarry R, Likes L, DesRosiers C, Frost S, Williams M: Extracranial stereotactic radioablation: Results of a phase I study in medically inoperable stage I non-small cell lung cancer. *Chest*, 124:1946-1955, 2003.
2. Whyte RI, Crownover R, Murphy MJ, Martin DP, Rice TW, DeCamp MM Jr, Rodebaugh R, Weinhaus MS, Le QT: Stereotactic radiosurgery for lung tumors: preliminary report of a phase I trial. *Ann Thorac Surg*, 75:1097-1101, 2003.
3. Schweikard A, Shiomi H, Adler Jr, JR: Respiration tracking in radiosurgery. *Med Phys*, 31(10): 2738-2741, 2004.

