UAB RADIOSURGERY PROGRAM
Hazelrig-Salter Radiation Oncology Center
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BIRMINGHAM AL 35249-6832

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THE UAB COMPREHENSIVE CANCER CENTER

To refer a patient to the UAB Radiosurgery Program or schedule appointments, contact UAB MIST at 1.800.822.6478.

For more information about the UAB Radiosurgery Program, visit uabmedicine.org/radiosurgery or uab.edu/radonc.

UAB MEDICINE
UAB COMPREHENSIVE CANCER CENTER

2011 UAB Radiosurgery Program Outcomes

UAB MEDICINE
UAB COMPREHENSIVE CANCER CENTER

Contents

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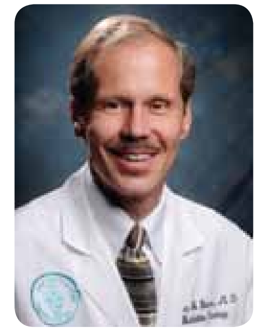
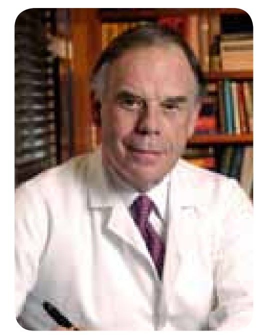
A Message From the Chairs



James A. Bonner, MD



Kirby I. Bland, MD

The 2011 UAB Radiosurgery Program Outcomes booklet continues our effort to provide our friends and colleagues an informative picture of how we are handling our mission to provide care to the citizens of Alabama and the region.

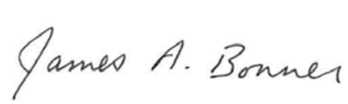
In UAB's culture of collaboration, the Department of Radiation Oncology and the Department of Surgery developed the UAB Radiosurgery Program. This special approach to patient care provides every patient requiring stereotactic radiation surgery with a reasoned and thorough evaluation of their situation, resulting in a recommended treatment plan. Treatment outcomes are completed as patients are treated and followed. The goal is to optimize treatments and add to the body of knowledge of the field.

As this interspecialty relationship has flourished, the program has maintained growth and the outstanding score in patient satisfaction you will see in this report.

As an update, we are pleased to report that the linear accelerator based radiosurgery program moved into a new building, the Hazelrig-Salter Radiation Oncology Center, in March 2010, providing our patients and their families with a more comfortable, attractive setting. Included in the new space is one of the first TrueBeam radiation devices in the world. TrueBeam is living up to its promise of delivering precise radiosurgical treatments in significantly less time than previously possible with other machines. For our patients, reduced treatment time means more accurate delivery and increased comfort. The improvement in delivery accuracy reduces the potential for collateral damage to nearby healthy tissue.

This type of continually updated technology, a faculty with more than 253 total years of experience in radiosurgery, and a clinical team that understands and supports our patients' individual needs all combine to pursue our goal of eventually curing cancer.

We invite your questions and comments. If you wish to learn more about the progress of our program, you may contact the Department of Radiation Oncology at 205.934.5670.



Merle M. Salter Professor and Chair
UAB Department of Radiation Oncology

Fay Fletcher Kerner Professor and Chair
UAB Department of Surgery

Thoracic Radiosurgery

Lung cancer is a disease that is too well known by too many people. Only 100 years ago, lung cancer was considered a rare and uncommon entity [1]. Medical literature at that time regarding lung cancer was limited to small studies and individual reports of an uncommon disease [2-5]. Now, scarcely three generations later, it is a leading cause of death and morbidity in the United States, with approximately 196,000 cases diagnosed each year. Of those, 158,000 will die from their disease.

Surgical resection of lung cancer has long been considered the standard of care when attempting to cure patients when the disease is diagnosed early and in a well-localized fashion. Unfortunately, many patients present with advanced disease that is not amenable to operative resection. Other patients, who otherwise would have resectable disease, are not candidates for surgery because of comorbidities such as heart disease. For patients who are unable to undergo surgical resection, high-dose radiation that is delivered daily for several weeks has been used in an effort to cure. This approach has produced less than satisfying results [6, 7]. Now, with the advent of thoracic radiosurgery, outcomes that are more comparable to surgery are possible [8].

Radiosurgery is not a new technology. It has been used for many years to treat cancers in the central nervous system [9]; however, its use in the lung has been

1. Witschi H. A Short History of Lung Cancer. *Toxicological Sciences.* 2001;64:4-6.

2. Ryn TC, Meyer FW. Bronchogenic Carcinoma. *U.S. Naval Bulletin.* 1949;49(5):863-867.

3. Hirsch EF. Bronchogenic Carcinoma of the Lung. *Illinois Med J.* 1949;95(4):241-243.

4. Corsello JN, O'Brien WB. Primary Bronchogenic Carcinoma, a report of 47 cases. *Rhode Island Med J.* 1947;30(1):15-20.

5. Eagan JC. Bronchgenic Carcinoma of the Lung; report of a case. *Nebraska State Med J.* 1948;31:94-98.

6. Haffty B, et al. Results of radical radiation therapy in clinical stage 1, technically operable non-small cell lung cancer. *Int J Radiat Oncol Biol Phys.* 1998;69-73.

7. Dosoretz D, et al. Radiation therapy in the management of medically inoperable carcinoma of the lung: Results and implications for future treatment strategies. *Int J Radiat Oncol Biol Phys.* 1992;24:3.

8. Palma D, Visser O, Lagerwaard F, Slotman B, Belderbos J, Senan S. A Population-Based Matched-Pair Comparison of Stereotactic Radiotherapy vs. Surgery for the Treatment of Stage I NSCLC in Elderly Patients. Chicago Multidiciplinary Symposium in Thoracic Oncology, Chicago, Dec 2010.

9. Leksell L. The Stereotaxic Method and Radiosurgery of the Brain. *Acta chir Scand.* 1951;102:316.

Cover photo: Depicts a patient on UAB's new Truebeam with Dr. Douglas Minnich, Dept of Surgery, and Dr. Chris Dobelbower, Dept of Radiation Oncology

10. Rusthoven KE, Kavanagh BD, Burri SH, Chen C, Cardenes H, Chidel MA, Pugh TJ, Kane M, Gaspar LE, Schefter TE. Multi-Institutional Phase I/II Trial of Stereotactic Body Radiation Therapy for Lung Metastases. *Journal of Clin Oncol.* 2009;27(10).

11. 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. *Chest.* 2003;124:1946-1955.

12. Fakiris AJ, McGarry RC, Yiannoutsos CT, Papiez L, Williams M, Henderson MA, Timmerman R. Steroetactic Body Radiation Therapy for Early-Stage Non-Small-Cell Lung Carcinoma: Four-Year Results of a Prospective Phase II Study. *Int J Radiat Oncol Biol Phys.* 2009;75(3):677-682.

13. Louie AV, Rodrigues G, Hannouf M, Palma DA, Cao JQ, Yaremko BP, Malthaner R, Mocanu JD, Zaric GS. Is Stereotactic Body Radiotherapy Warranted in Medically Operable Stage I NSCLC? A Markov Model Based Decision Analysis. Chicago Multidisciplinary Symposium in Thoracic Oncology, Chicago, Dec 2010.

14. Timmerman RD, Park C, Kavanagh BD. The North American Experience with Stereotactic Body Radiation Therapy in Non-small Cell Lung Cancer. *J Thorac Oncol.* 2007;2(7) Supplement 3.

a far more challenging problem for numerous reasons. The first among these is that the lung is in motion. Thus, the challenge is to hit a moving target with great precision. Other challenges include visualizing small tumors with great accuracy and dose calculation challenges in the lungs that are unique from other sites in the body. Technological advances in radiation treatment machines, such as the Varian TrueBeam™ STx radiosurgical machine and the superDimension® navigational bronchoscopy system, have solved many of the problems associated with thoracic radiosurgery. In fact, numerous currently ongoing clinical trials are testing the safety and efficacy of expanding the use of thoracic radiosurgery. Early results from several institutions have shown that this approach is not only safe, but also can produce similar cancer-free survivals to surgery at 3 years and have less morbidity in the short term [8,10-13]. In fact, control rates for thoracic tumors treated with radiosurgery now range from 80 percent to more than 90 percent [14].

Thoracic radiosurgery at UAB is performed by a multidisciplinary team including thoracic surgeons, radiation oncologists, dosimetrists, and medical physicists. The process begins with the diagnosis of malignancy. New tools for the diagnosis of cancer with minimally invasive approaches, such as navigational bronchoscopy are used at UAB to diagnose the malignancy and to place markers into the tumor for targeting by the radiation machine. Once a diagnosis is made, patients undergo a specialized planning CT scan to identify the tumor and nearby structures that need to be protected from the radiation. The radiosurgery team then develops and tests an individualized treatment plan. Radiation is subsequently delivered, usually in one to five treatments over the next 1 to 2 weeks, with each treatment generally lasting less than 30 minutes. The treatments are performed on an outpatient basis, are painless, and only require that the patient lie still during treatment.

Thoracic radiosurgery is an exciting and promising new therapy for patients with medically inoperable early-stage lung cancer. The ultimate role that thoracic radiosurgery will have in the treatment of lung cancer is yet to be defined. Large clinical trials evaluating its efficacy are exploring new indications for this treatment, and the long-term effects remain unknown. What is clear is that thoracic radiosurgery does offer a chance for cure in patients who previously would have had limited treatment options.

TrueBeam: State-of-the-Art Image-Guided Radiotherapy and Radiosurgery

Last year, the UAB Department of Radiation Oncology was among the first institutions in the world to deploy a TrueBeam™ system for image-guided radiotherapy and radiosurgery. Designed to treat a moving target with unprecedented speed and accuracy, TrueBeam incorporates numerous technical innovations that dynamically synchronize imaging, patient positioning, motion management, and treatment delivery during a radiotherapy or radiosurgery procedure.

One important feature of the TrueBeam system is its high-intensity mode, which makes it possible to deliver doses up to four times faster than can be accomplished with other radiosurgery machines, significantly shortening treatment times. Cutting down treatment time by a factor of two to four makes a big difference to patients and can enhance treatment accuracy by leaving less time for tumor motion during dose delivery. Using the TrueBeam system, a standard intensity-modulated treatment that would typically take 10 minutes can be completed in less than two minutes. Simple RapidArc treatments, which used to be done in 2 minutes, can now be completed in 1 minute.

UAB clinicians have used the TrueBeam system to deliver fast, highly precise treatment for tumors of the brain, spine, lung, liver, prostate, head and neck, and pancreas. The system is extremely flexible, allowing for selection of an optimal treatment approach in each case, from intensity-modulated radiotherapy (IMRT) to stereotactic radiosurgery (SRS), from stereotactic body radiotherapy (SBRT) to volumetric arc (RapidArc®) therapy. In addition, a new gated RapidArc capability allows it to be used with tumors that are subject to respiratory motion, such as many tumors of the lung or liver.

"Intelligent" automation further speeds treatments with an up to fivefold reduction in the number of steps needed for imaging, positioning, and treating patients. A nine-field IMRT treatment that would have required 52 separate steps or mouse-clicks using earlier generations of technology can now be completed in less than ten

LOCATIONS

UAB Highlands

Cranial radiosurgery with the Leksell Gamma Knife®
1201 11th Avenue South
Birmingham, AL 35205

The Kirklin Clinic® at Acton Road

SBRT with TomoTherapy® and with the Varian EX® linear accelerator
2145 Bonner Way
Birmingham, AL 35243

Hazelrig-Salter Radiation Oncology Center

SBRT with the Varian iX linear accelerator and TrueBeam accelerator
1700 6th Avenue South
Birmingham, AL 35233

steps. As a result, UAB radiation therapists can focus more of their attention on the patient and on the progress of the treatment.

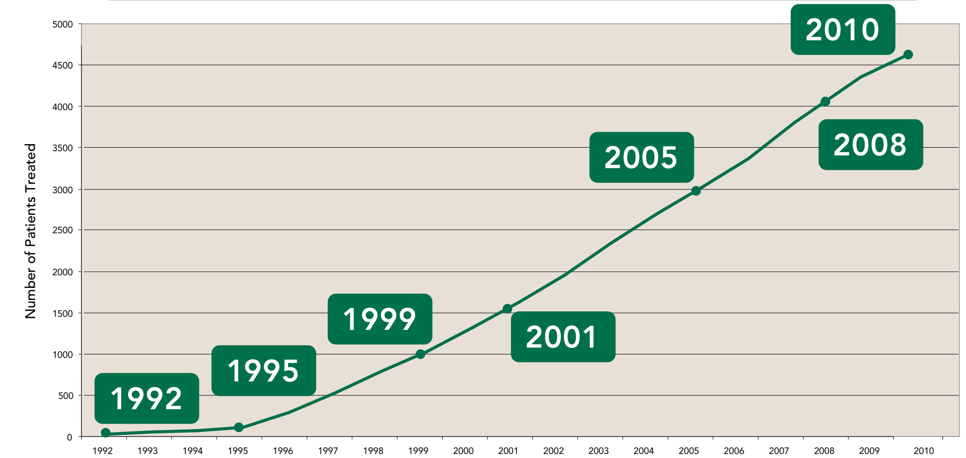
The precision of a TrueBeam system is measured in increments of less than a millimeter. This accuracy is made possible by the system's sophisticated architecture, which establishes a new level of synchronization between imaging, patient positioning, motion management, beam shaping, and dose delivery technologies. Accuracy checks are performed every 10 milliseconds throughout the treatment. More than 100,000 data points are monitored continually as a treatment progresses, ensuring that the system maintains a true isocenter, or focal point of treatment.

The TrueBeam imager, which is used to localize a tumor just prior to treatment, can generate 3-D anatomical images in 60 percent less time, with a 25 percent reduction in X-ray dose to the patient, when compared with earlier generations of technology.

We are excited about this powerful and fully integrated high-end system and regard it as a significant step forward in our ongoing commitment to providing patients with access to the best of available contemporary radiosurgical technology.

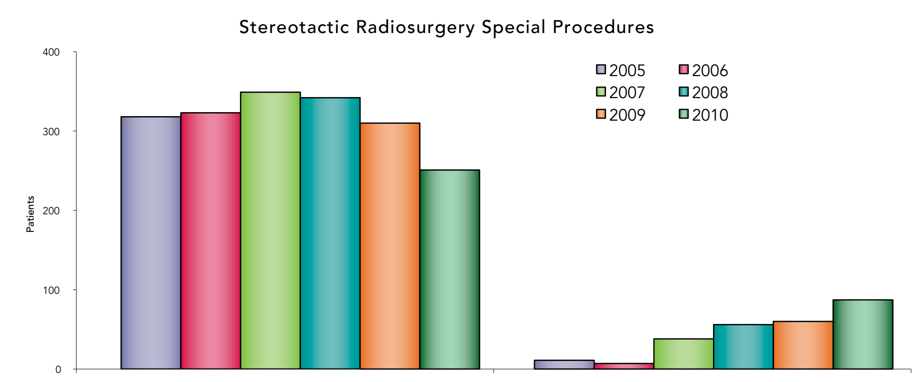
Quality and Outcome Measure

TIMELINE OF OUR SUCCESS



1992	First patient treated with stereotactic radiosurgery (linac)
1995	First CNS case treated with Gamma Knife
1999	First FDA-approved IMRT-delivering device
2001	First in Alabama to offer RPM Gating System
2005	First in Alabama to treat with stereotactic body radiation therapy
2008	First in the U.S. to treat with volumetric arc therapy (RapidArc™)
2010	One of the world's first facilities to offer TrueBeam system (third in the United States)

SELECTED DISEASE SITES



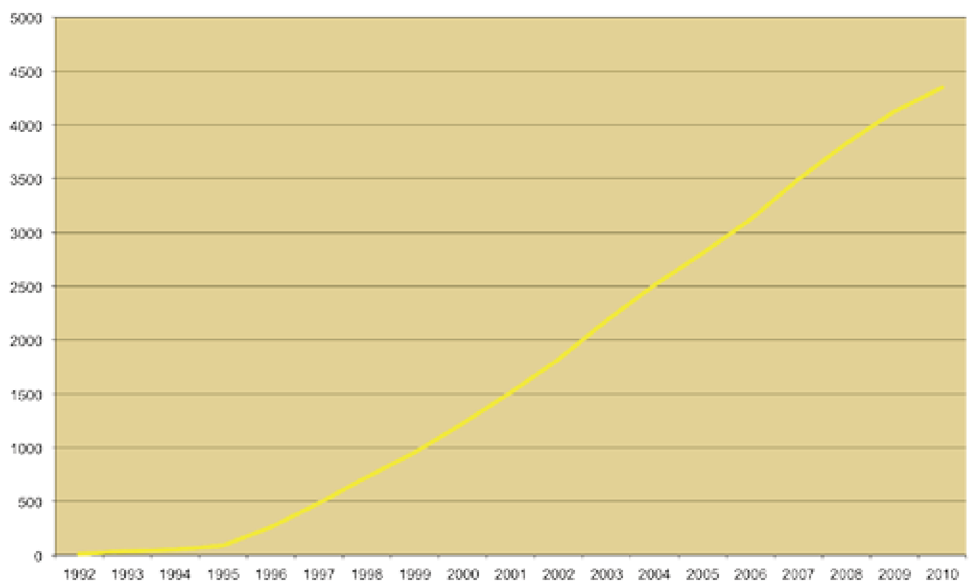
The UAB Radiosurgery Program offers state-of-the-art treatment therapies and technologies for a wide variety of body sites, including central nervous system (CNS), lung, spine, and others. CNS tumors essentially are treated with the Gamma Knife. Tumors or malformations of the liver, lung, spine, and other body sites are treated using SBRT. The following charts show the outcome measures of selected body sites treated with cranial radiosurgery and SBRT at UAB.

Special Procedures on Selected Disease Sites

Gamma Knife	**1883**	**Stereotactic Body Radiation Therapy**	**265**
Benign	393	Brain	13
Malignant	981	Lung	94
Trigeminal Neuralgia	352	Liver	19
Vascular	157	Spine	89
		Other	50

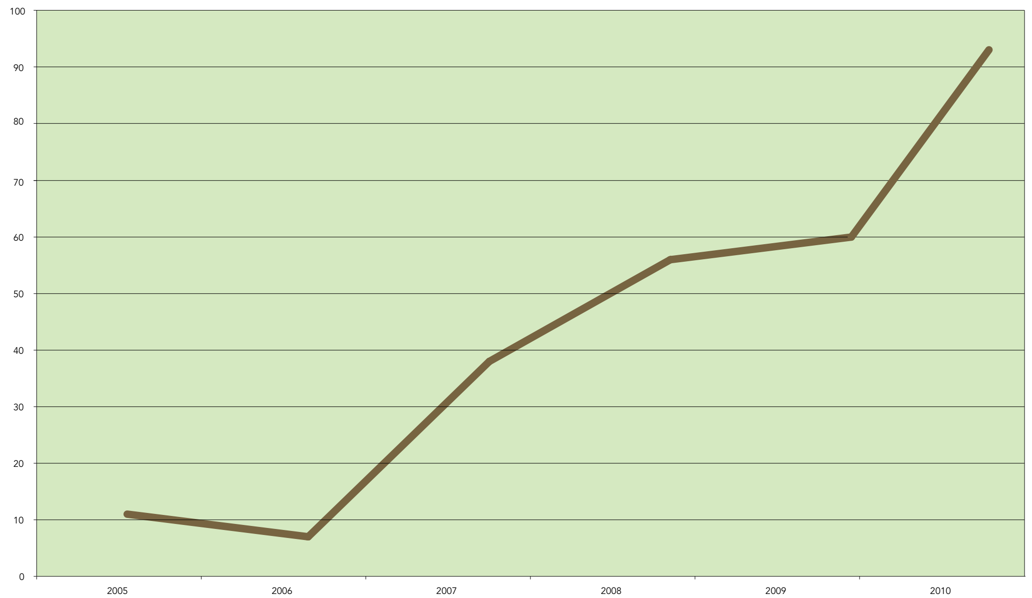
Quality and Outcome Measure

CRANIAL RADIOSURGERY PROCEDURES



The Leksell Gamma Knife is a highly advanced technology that delivers 201 tightly focused cobalt radiation beams to one point in the brain. The radiation beams and doses are so precise they affect only the targeted tissue and relatively spare the surrounding healthy tissue.

SBRT PROCEDURES



Stereotactic Body Radiation Therapy (SBRT) uses a high dose of radiation shaped to conform to the patient's tumor. It delivers radiation to the intended target and avoids healthy tissue. Small tumors are accurately identified and located with precise coordinates.

2011 Radiosurgery Noteworthy Publications

Brown PD, Kee AY, Eshleman JS, Fiveash JB. Adjuvant whole brain radiotherapy: strong emotions decide but rationale studies are needed: in regard to Brown et al. (*Int J Radiat Oncol Biol Phys.* 2008;70:1305-1309). In reply to Drs. Larson and Sahgal. *Int J Radiat Oncol Biol Phys.* 2009 Sep;75(1):316-7.

Clark GM, Popple RA, Young PE, Fiveash JB. Feasibility of single-isocenter volumetric modulated arc radiosurgery for treatment of multiple brain metastases. *Int J Radiat Oncol Biol Phys.* 2010;76(1):296-302.

Dobelbower MC, Nabell L, Markert J, Carroll W, Said-Al-Naief N, Meredith RF. Cancer of the Tonsil presenting as Central Nervous System Metastasis: A Case Report. *Head & Neck.* 2009;31:127-30.

Prendergast BM, Bonner JA, Popple RA, Spencer SA, Fiveash JB, Keene KS, Cerfolio RJ, Minnich DJ, Dobelbower MC. Dosimetric analysis of imaging changes following pulmonary stereotactic body radiation therapy. *J Med Imaging Radiat Oncol.* 2011;55(1):90-6.

Prendergast BM, Popple RA, Spencer SA, Minnich DJ, Dobelbower MC. Flattening filter-free mode improves clinical efficiency for pulmonary and hepatic SBRT in American College of Radiation Oncology Annual Meeting. San Diego, Feb 2011.

Sawrie SM, Fiveash JB, Caudell JJ. Stereotactic body radiation therapy for liver metastases and primary hepatocellular carcinoma: normal tissue tolerances and toxicity. *Cancer Control.* 2010;17(2):111-119.

Spencer SA, Swaid S, Guthrie B, Young P, Wond W, Meredith RF, Markert J, Fisher W, Wu J, Nordal R, Fiveash JB. Impact of Dose Rate on Outcomes of Gamma Knife Radiosurgery in Patients with Face Pain. McDermott MW (ed): *Radiosurgery.* Basel, Garger, 2010, 7: 360-365.

Stewart JG, Sawrie SM, Bag A, Han X, Fiveash JB. Management of Brain Metastases. *Curr Treat Options Neurol.* 2010;12(4):334-346.

2010 Radiosurgery publication mistake: The following publication is not from our Dr. Sharon Spencer-UAB.

Spencer SS. Gamma knife radiosurgery for refractory medial temporal lobe epilepsy: Too little, too late? *Neurology.* 2008;70(19):1654-5. No abstract available. PMID: 18458224 [PubMed - indexed for MEDLINE]

EDUCATIONAL SITE VISITS TO UAB

- McLeod Medical Center, August 2010
- Renown Medical Center, Reno, NV, September 2010
- Exeter Hospital Manchester, NH, October 2010
- Mayo Clinic, Jacksonville, FL, October 2010
- Baptist Memorial Hospital-DeSoto, Southaven, MS, November 2010
- Landenau Hospital, Wynnewood, PA, November 2010
- Memorial Medical Center, Modesto, CA, November 2010
- University of Arkansas For Medical Sciences, Little Rock, AR, December 2010
- Florida Hospital, Orlando, FL, December 2010

Faculty Presentations

MICHAEL DOBELBOWER, MD, PhD

Thoracic Radiosurgery, How we got here (and what we think we know)
8th Annual Simon Kramer Institute Oncologic Symposium, Simon Kramer Institute of Therapeutic Oncology, New Philadelphia, PA
Audience: Physicians with practices related to oncology
May 22, 2010

JOHN B. FIVEASH, MD

Initial Clinical Experience with TrueBeam
ASTRO Convention, UCSD, San Diego, CA
October 30, 2010

Eclipse/TrueBeam Clinical Demonstration
University of Florida Radiosurgery Course, Orlando, FL
December 10, 2010

Advancing Technology for Therapeutic Gain (Clinical Forums CME)
Denver, CO
January 26, 2011

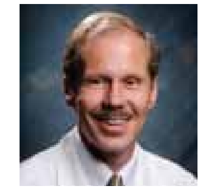
CHRISTOPHER D. WILLEY, MD, PhD

SBRT and Clinical Applications in Radiation Therapy
Eastern Shore Oncology Conference, Salisbury, MD
November 12, 2009

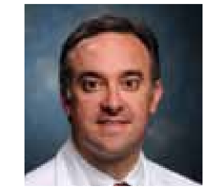
4D IGRT – Certain Phase of Respiration
American Association of Medical Dosimetrists Region IV Dosimetry Conference, Burlington, VT
October 24, 2009

Adaptive Radiotherapy: New Technologies & New Applications for IG-IMRT, SBRT, and SRS
Varian Clinical Solutions Forum, Old Greenwich, CT
March 12, 2009

UAB Radiosurgical Clinical Faculty

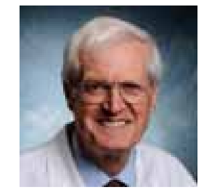


James A. Bonner, MD
Radiation Oncology
Specialties: lung, head and neck

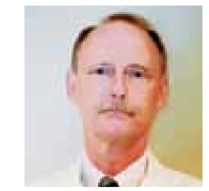


John Fiveash, MD
Radiation Oncology
Specialties: CNS, GU, gynecological, ocular melanoma, pediatrics, sarcoma

Richard Popple, PhD
Medical Physicist
Specialty: physics

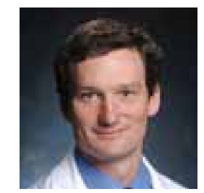


Ivan Brezovich, PhD
Medical Physicist
Specialty: physics



Barton L. Guthrie, MD
Neurosurgery
Specialties: brain tumors, face pain

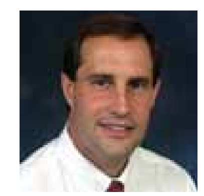
Prem Pareek, PhD
Medical Physicist
Specialty: physics



O.L. Burnett III, MD
Radiation Oncology
Specialties: GU, gynecological, lymphoma, pediatrics, breast, sarcoma, GI

Rojymon Jacob, MD
Radiation Oncology
Specialties: CNS, GI, GU, sarcoma, benign disease

Kristen Riley, MD
Neurosurgery
Specialties: brain tumors, epilepsy, spine



Robert Cerfolio, MD
Thoracic Surgery
Specialty: thorax

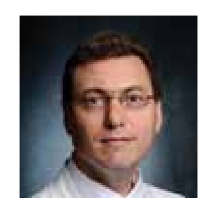
Kimberly Keene, MD
Radiation Oncology
Specialties: breast, GI, head and neck, pediatrics, skin

Sui Shen, PhD
Medical Physicist
Specialty: physics

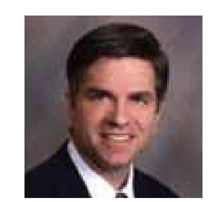
Jennifer De Los Santos, MD
Radiation Oncology
Specialties: breast, gynecological, lung, lymphoma, sarcoma, skin

Robert Kim, MD
Radiation Oncology
Specialties: GU, gynecololgical, ocular melanoma, orbital tumors

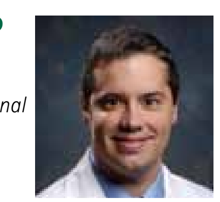
Sharon Spencer, MD
Radiation Oncology
Specialties: breast, CNS, GI, gynecological, head and neck, lung, lymphoma, orbital tumors, ocular melanoma, pediatrics, sarcoma, skin



Michael Dobelbower, MD, PhD
Radiation Oncology
Specialties: benign disease, CNS, GI, GU, head and neck

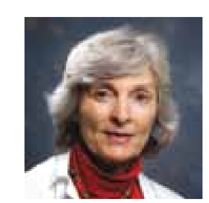


James A. Markert, MD
Neurosurgery
Specialties: brain tumors, spinal radiosurgery, trigeminal neuralgia

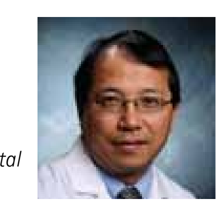


Christopher Willey, MD, PhD
Radiation Oncology
Specialties: breast, CNS, head and neck, lung, pancreas

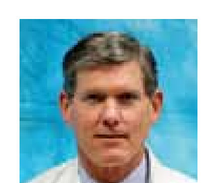
Juan Duan, PhD
Medical Physicist
Specialty: physics



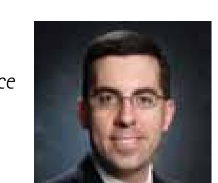
Ruby Meredith, MD, PhD
Radiation Oncology
Specialties: benign disease, breast, CNS, GI, head and neck, lung, lymphoma, orbital tumors, skin



Xingen Wu, PhD
Medical Physicist
Specialty: physics



Winfield S. Fisher, MD
Neurosurgery
Specialties: brain tumors, face pain, vascular



Douglass J. Minnich, MD
Thoracic Oncology
Specialty: thorax

Eddy Yang, MD
Radiation Oncology
Specialties: lung, GU, breast, head and neck