UAB RADIOSURGERY PROGRAM
Hazelrig-Salter Radiation Oncology Center
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For information about the UAB Radiosurgery Program, visit uabmedicine.org/radiosurgery or uab.edu/radonc

UAB MEDICINE
UAB COMPREHENSIVE CANCER CENTER

2012 UAB Radiosurgery Program Outcomes

UAB MEDICINE
UAB COMPREHENSIVE CANCER CENTER

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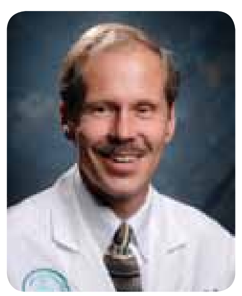
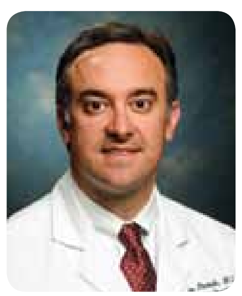
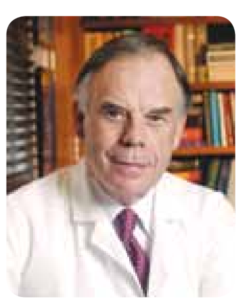


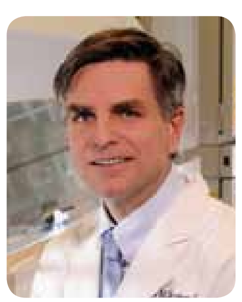
James A. Bonner, MD



John B. Fiveash, MD



Kirby I. Bland, MD



James M. Markert, Jr, MD, MPH

A Message From the Chairs

The 2012 UAB Radiosurgery Program Outcomes booklet continues our effort to communicate the strides our team has made in providing the best possible care to the citizens of Birmingham and beyond.

We believe that the innovative techniques being harnessed within our program make UAB a standout in patient care, research, and education. Advancing treatments for optimal patient care and outcomes, as well as contributing to the body of radiosurgery knowledge, is helping us work toward our ultimate goal of developing better cancer therapeutics.

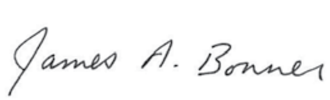
Two of our most exciting and cutting-edge treatments are discussed in this booklet: triggered imaging technique for thoracic radiosurgery and Gamma Knife radiosurgery for pituitary tumors. Each of these care tactics builds on the Radiosurgery Program's culture of collaboration and aim of providing our patients with care that is as individualized as they are.

Triggered imaging for thoracic surgery is the newest development in motion management at UAB and allows our care teams to even more accurately deliver treatment to our patients. Thoracic radiosurgery is a technically complex procedure that requires advanced technologies and multidisciplinary care, which in Alabama are available uniquely at UAB.

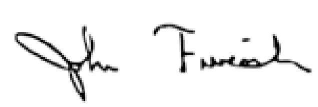
For the treatment of pituitary adenomas that require salvage treatment, Gamma Knife radiosurgery offers a precise, successful treatment modality. This salvage therapy offers a high rate of controlling the tumor while minimizing potential radiation-induced damage to adjacent normal tissue—an advantage that decreases the risk of neurocognitive impairment and secondary malignancy.

These strides in patient treatment combined with our comprehensive team approach are a hallmark of our radiosurgery program. We strive to deliver these treatments with a patient-centered approach that allows for compassionate and superior care for each and every patient.

We welcome any questions and comments you may have. If you would like to learn more about the progress of our program, you may contact the Department of Radiation Oncology at 205.934.5670.

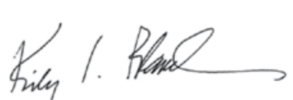


Merle M. Salter Professor and Chair
UAB Department of Radiation Oncology



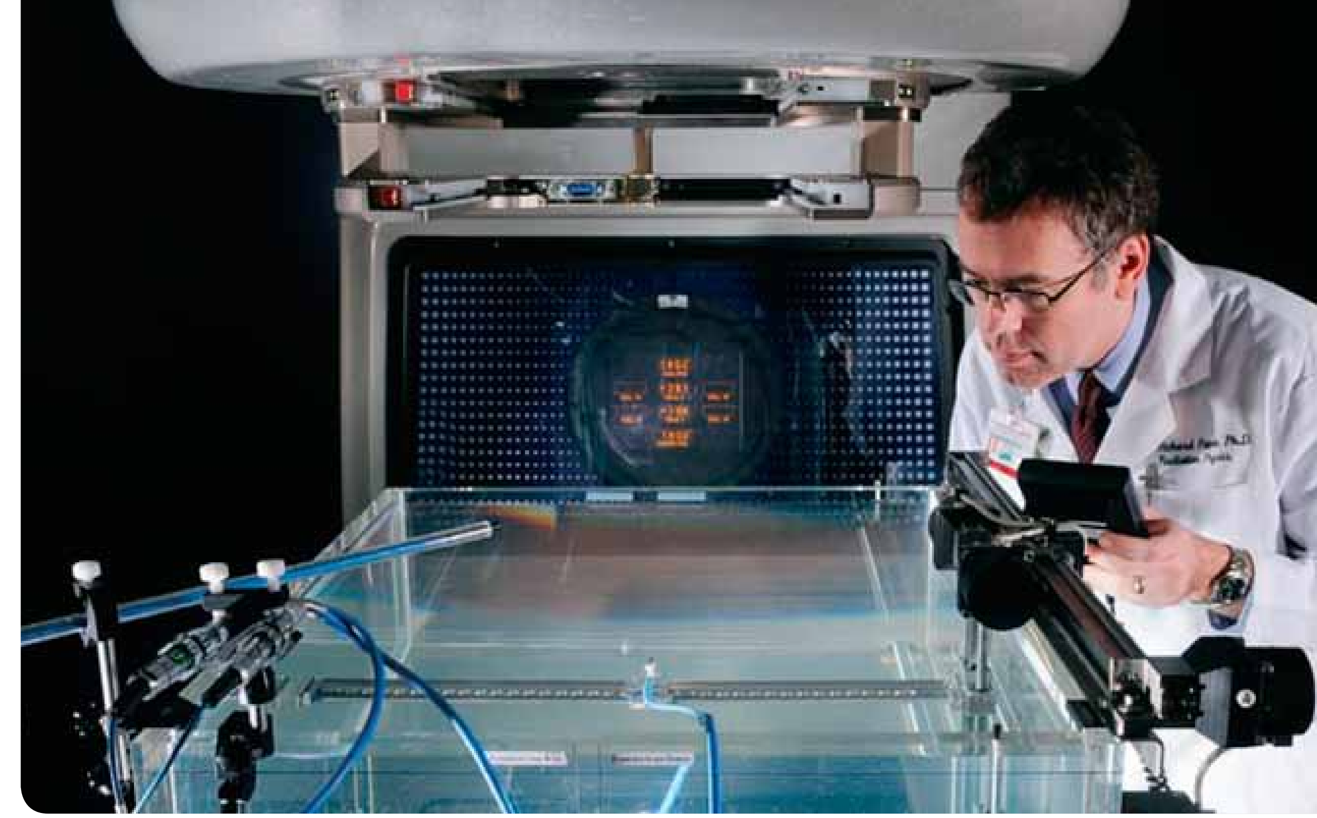
Robert Y. Kim Endowed Chair, Professor and Vice Chair
UAB Department of Radiation Oncology

Interim Associate Director for Clinical Research
UAB Comprehensive Cancer Center



Fay Fletcher Kerner Professor and Chair
UAB Department of Surgery

James Garber Galbraith Endowed Chair, Professor and Director
UAB Division of Neurosurgery



Above: Dr. Richard Popple

Triggered Imaging Technique for Thoracic Radiosurgery

At UAB, a new technique called triggered imaging is being used to monitor tumor position in real-time during thoracic radiosurgery. Triggered imaging is improving the accuracy and precision of radiosurgery.

Radiosurgery is becoming an increasingly important tool for managing lung cancer in non or marginally operable patients, with outcomes comparable to surgery [8]. Numerous multi-institutional clinical trials are ongoing, with early results showing that this approach is safe and can result in cancer-free survivals at three years similar to surgery with less morbidity in the short term [8,10-13]. Reported control rates for thoracic tumors treated with radiosurgery have reached more than 90 percent [14].

Thoracic radiosurgery is technically challenging, requiring accurate targeting of the radiation beam so that the tumor receives the full, ablative radiation dose while dose to healthy tissue is minimized. To assure the best possible outcome, radiosurgery at UAB is performed by a multidisciplinary team comprised of thoracic surgeons, radiation oncologists, and medical physicists. Team members work in close collaboration throughout the entire treatment process, from initial consultation to the radiosurgical procedure, to patient follow up.

A particularly complex technical challenge facing thoracic radiosurgery is respiratory motion of the tumor. Tumor motion is highly variable; Tumors at the apex of the lung typically remain stationary, while diaphragmatic tumors can move as much as 4 cm (K. M. Langen., And D. T. L. Jones, "Organ motion and its management," *Int. J. Radiation Oncology Biol. Phys.*, Vol. 50, No. 1, pp. 265–278, 2001). At UAB, management of tumor motion begins with the thoracic surgeon. Using navigational bronchoscopy, the surgeon implants fiducial markers in the tumor. Conventional bronchoscopic techniques cannot reach many tumors, for which the only other option for implanting fiducial markers is trans-thoracically. The trans-thoracic approach has a pneumothorax rate as high as 30% (Yousefi S, Collins BT, Reichner CA, Anderson ED, Jamis-Dow C, Gagnon G, Malik S, Marshall B, Chang T, Banovac F. Complications of thoracic computed tomography-guided fiducial placement for the purpose of stereotactic body radiation therapy. *Clin Lung Cancer.* 2007 Jan;8(4):252-6.), compared to less than 6% for navigational bronchoscopy (Schroeder C, Hejal R, Linden PA. Coil spring fiducial markers placed safely using navigation bronchoscopy in inoperable patients allows accurate delivery of CyberKnife stereotactic radio surgery. *J Thorac Cardiovasc Surg.*

Cover photo: Dr. Sharon Spencer, Dr. Barton Gurthrie, and Dr. Kristen Riley

Above: Dr. Douglas Minnich and Dr. Michael Dobelbower

2010 Nov;140(5):1137-42. Epub 2010 Sep 20.; Harley DP, Krimsky WS, Sarkar S, Highfield D, Aygun C, Gurses B. Fiducial marker placement using endobronchial ultrasound and navigational bronchoscopy for stereotactic radiosurgery: an alternative strategy. *Ann Thorac Surg.* 2010 Feb;89(2):368-73; discussion 373-4). At UAB, we have had no pneumothoraces with fiducial placement. The markers are typically implanted during a diagnostic bronchoscopy, so the patient does not need to undergo an additional procedure.

After bronchoscopy, the radiation oncologist and the thoracic surgeon consult to determine the best treatment strategy. Once the decision has been made to use radiosurgery, the patient receives a CT scan to identify the tumor and nearby healthy structures that need to be protected from the radiation. The CT scan is the next stage in the management of tumor motion. During the scan, an optical technique is used to measure the chest motion. The scan is a special type, called a 4D CT, composed of 10 complete 3-dimensional CT image sets. Each CT corresponds to a snapshot at a different point in the respiratory cycle, which is correlated with the chest motion.

One method to ensure that the tumor remains within the radiation beam is to simply treat the entire volume encompassed by tumor motion. However, this approach results in a relatively large volume of lung receiving a high radiation dose (Wu J, Li H, Shekhar R, Suntharalingam M, D'Souza W., "An evaluation of planning techniques for stereotactic body radiation therapy in lung tumors," *Radiother Oncol.* 2008 Apr;87(1):35-43. Epub 2008 Mar 24). This approach is particularly undesirable in the context of the high, ablative radiation dose delivered by radiosurgery. An alternative approach preferred at UAB is to gate the radiation beam, turning it on only at the end of expiration, when the lung is at rest and the tumor is relatively stationary. The scans are evaluated for tumor motion by the medical physicist, who determines the optimal point in breathing cycle to turn the radiation beam on and off. The medical physicist also locates the fiducial markers in the CT images. The radiosurgery team then develops and tests an individualized treatment plan. The dose distribution is sculpted to tightly conform to the tumor and limit radiation dose to the lung, chest wall, and other healthy tissues.

The final and most critical step in motion management is treatment, usually one to five treatments over one to two weeks. Prior to starting radiation delivery, x-rays are taken to ensure that the tumor is in the correct position. The fiducial markers are easily seen in the x-rays and are compared with outlines of the expected position, derived from the 4D CT scan and the preparation by the medical physicist. If the outline and the image on the x-ray do not coincide, the patient is shifted until they do. When the patient is in the correct position and the tumor is centered in the radiation beam, the beam is turned on. During treatment, the same optical technique used during the CT scan is used to track the patient's breathing. The optical system instructs the radiation beam to turn on at the end of expiration and to turn off as inspiration begins.

The newest development in motion management at UAB is triggered imaging. Using triggered imaging, we observe the fiducial marker during treatment delivery. At the beginning of each expiratory cycle, immediately before the radiation beam comes on, an x-ray image is taken. The image is displayed along with a circle around the expected position of the fiducial marker. The radiation oncologist and thoracic surgeon are thus able to monitor the position of the tumor in real time as the treatment progresses. If the patient moves or the breathing pattern changes, treatment is suspended, the position corrected, and treatment resumed.

Above: Fiducial marker during treatment delivery

Thoracic radiosurgery is a technically complex procedure requiring advanced technologies and multidisciplinary care, which in Alabama are available uniquely at UAB. The experienced team at UAB will continue to remain at the forefront of innovation as the technologies for thoracic radiosurgery continue to evolve.

Gamma Knife Radiosurgery for Pituitary Tumors

Pituitary adenomas represent one of the most common intracranial neoplasms. Found in 10-15% of the population, these benign tumors often pose complex management situations. While the majority of pituitary tumors can be treated with medication or surgery alone, a significant proportion require salvage treatment. Pituitary tumors that generally require additional treatment include functional tumors not controlled with surgery or medication and nonfunctional tumors that recur following surgery.

Gamma Knife radiosurgery offers a precise, successful treatment modality for pituitary adenomas. Tumor growth can be controlled in 90% of patients treated, frequently with reduction in tumor volume. Radiosurgery effects on biochemical cure vary depending on tumor type. (Sheehan et al 2011). Patient selection for radiosurgery depends on endocrine evaluation, tumor size, location, growth pattern, and pathology.

Pituitary adenomas are classified according to size and endocrine profile. Microadenomas, defined as smaller than 10mm in size, rarely cause clinical concern due to size, but may require treatment if they are functionally active. Macroadenomas, larger than 10mm, may cause visual difficulty if the optic pathways become compressed by the tumor. Located at the base of the skull, pituitary tumors occur adjacent to many critical structures such as the optic nerves, optic chiasm, cranial nerves within the cavernous sinuses, carotid artery, and brainstem. The location of these tumors requires specialized knowledge and techniques for management.

Additionally, pituitary adenomas often have either hormone overproduction or deficiency. All management decisions regarding these tumors require a multidisciplinary approach. While many tumors require only observation, a significant number have endocrine and anatomical implications that must be addressed.

The UAB Neurosurgical Pituitary Disorders Clinic offers comprehensive evaluation and care for patients with pituitary tumors. Following diagnosis, whether for an incidentally found tumor or a symptomatic pituitary adenoma, appropriate evaluation includes imaging review, endocrine evaluation, and often ophthalmologic evaluation. Observation, medical therapy, surgery, and radiation therapy comprise the armamentarium of treatment options for pituitary tumors.

Functional tumors, those that result in overproduction of hormones, often require multi-modality treatment. Prolactinomas are the most common functional pituitary tumors. For prolactinomas, medical therapy with dopamine agonists is the standard of care for first line treatment. However, for patients not controlled with medication or who do not tolerate medication, surgery and radiation may be utilized. Pituitary tumors resulting in acromegaly, from excess growth hormone and Cushing's disease from excess ACTH, require treatment regardless of size. Surgery is the first line of treatment for the majority of these tumors. In cases where a surgical cure is not achieved, additional therapy is paramount due to the significant increase in morbidity and mortality if hormone overproduction is not controlled. For patients with Cushing's disease, there is no available medical treatment to suppress steroid production. Radiosurgery offers a potential for cure.

In acromegaly, controversy exists regarding the timing of radiation therapy related to medical therapy. Medical therapy is often successful in normalizing growth hormone production, but at a significant yearly financial cost. Without controversy, is the use of radiation when patients are not controlled with medical therapy. However, there may be utility in radiation treatment in an attempt to shorten the length of time a patient requires medical therapy. Data suggests radiosurgery offers a greater than 50% rate of cure for growth hormone secreting pituitary tumors. (Sheehan et al 2011)

Sheehan JP, Pouratian N, Steiner L, Laws ER, Vance ML. Gamma Knife surgery for pituitary adenomas: factors related to radiological and endocrine outcomes. *J Neurosurg*. 2011 Feb: 114 (2) 303-9.

Taussky P, Kalra R, Coppens J, Mohebali J, Jensa R, Couldwell WT. Endocrinological outcome after pituitary transposition (hypophysopexy) and adjuvant radiotherapy for tumors involving the cavernous sinus. *J Neurosurg*. 2011 Jul; 115(1): 55-62.

For residual nonfunctional adenomas following surgery, Gamma Knife radiosurgery is considered if there is observed tumor growth over time or if the pathology is atypical pituitary adenoma, indicating a potentially higher chance of tumor recurrence. The recurrence rate of pituitary adenomas following surgery is reported around 20%. Recurrence is influenced by extent of resection and tumor pathology. Patients with pituitary adenomas are followed postoperatively with yearly imaging. The majority of tumor recurrence is seen in the first five to seven years postoperatively, but can occur later.

Following any radiation to the sella, patients should have a yearly endocrine evaluation. Secondary hypopituitarism is the most common side effect of radiosurgery for pituitary adenomas. The incidence of secondary hormone deficits increases with time, thus necessitating long-term endocrine surveillance. Gamma Knife radiosurgery may have a decreased rate of endocrine dysfunction over fractionated radiation due to the ability to precisely deliver radiation to the tumor and limit radiation to the normal gland in some patients. (Taussky et al 2011) In addition to minimizing dose to the normal pituitary gland, radiosurgery allows for treatment delivery that minimizes radiation to adjacent normal brain cells. This precision decreases the risk of neurocognitive impairment and secondary malignancy from radiation.

Appropriate patient selection and experienced treatment planning help to minimize the risks of radiosurgery. The anatomical location of the pituitary tumor necessitates careful evaluation and planning to limit toxicity to critical structures. Gamma Knife, with frame based head fixation, offers the most precise method of radiation delivery. In this area, millimeters matter. At UAB, we feel strongly that Gamma Knife precision allows us to perform safe, successful radiosurgery for pituitary tumors.

For more information or to refer a patient to the Multidisciplinary Pituitary Clinic: Contact Michel Thomas, Office Assistant to Dr. Riley, at 205-996-2461.

Quality and Outcome Measure

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

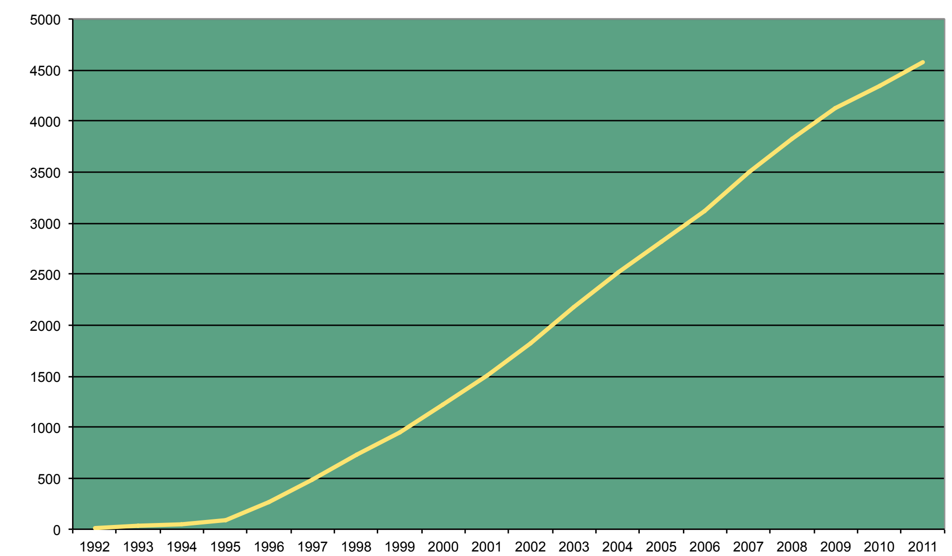
2005 First in Alabama to treat with stereotactic body radiation therapy

2008 First in the U.S. to treat with volumetric arc therapy (RapidArc™)

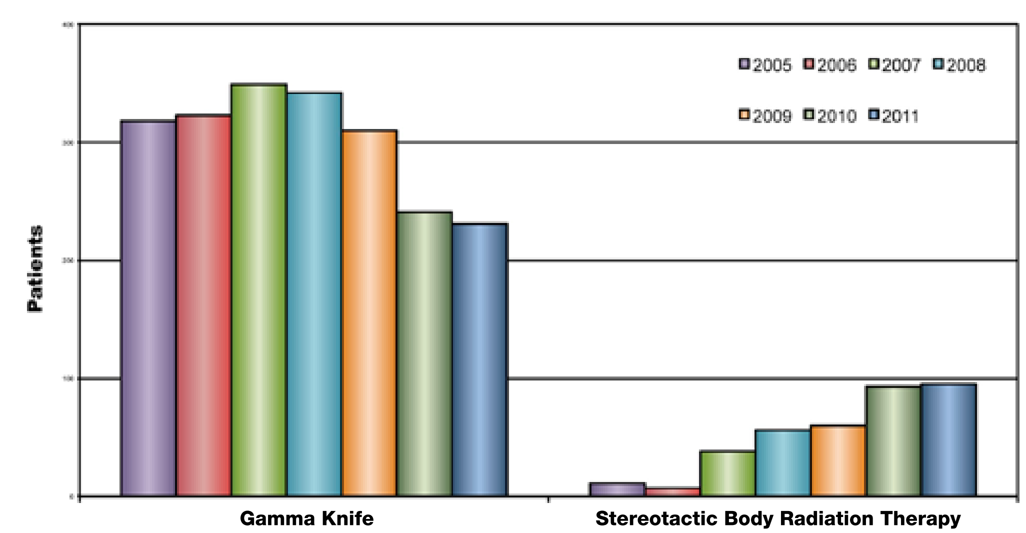
2010 One of the world's first facilities to offer TrueBeam system (third in the United States)

2011 First in the world to use "Triggered Imaging" Technology from Varian Medical Systems to continually monitor tumor location during radiosurgery for lung cancer

TIMELINE OF OUR SUCCESS



SELECTED DISEASE SITES



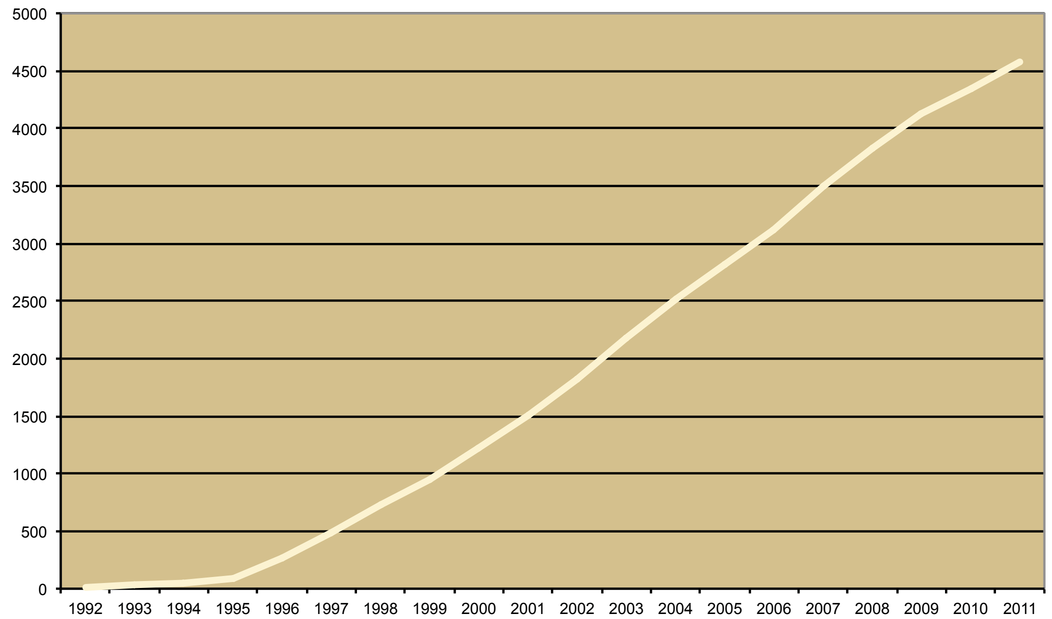
The UAB Radiosurgery Program offers state-of-the-art treatment therapies and technologies for a wide variety of body sites, including central nervous system (CNS), lung, spine, and others. CNS tumors essentially are treated with the Gamma Knife. Tumors or malformations of the liver, lung, spine, and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

Gamma Knife	2114
Benign	432
Malignant	1083
Trigeminal Neuralgia	409
Vascular	188
Seizure	2

Stereotactic Body Radiation Therapy	363
Brain	36
Lung	129
Liver	24
Other	53
Spine	121

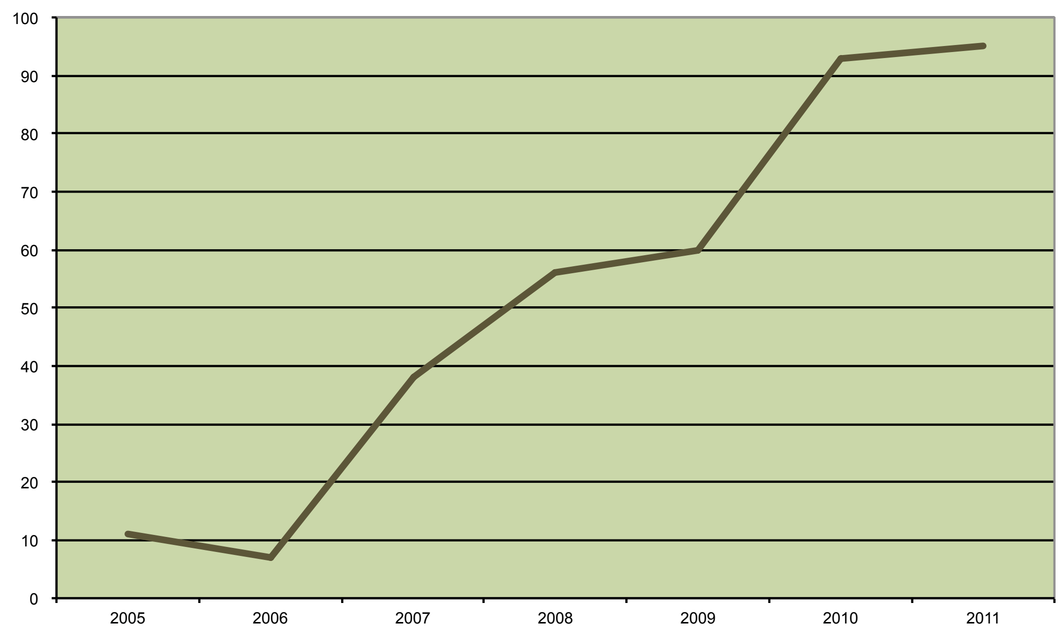
Quality and Outcome Measure

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 generally 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.

2012 Radiosurgery Noteworthy Publications

Clark GM, Popple RA, Prendergast BM, Spencer SA, Thomas EM, Stewart JG, Guthrie BL, Markert JM, Fiveash JB: Plan quality and treatment planning technique for single isocenter cranial radiosurgery with volumetric modulated arc therapy. *Practical Radiation Oncology.* Published online February 1, 2012. Citation Pending.

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

Fiveash J, Guthrie BG, Duan J, Markert JM, DeLosSantos JF, Keene KS, Spencer SA, Dobelbower MC, Arafat W, Popple RA. A Phase II Isotoxicity Study of Spinal Radiosurgery/SBRT. *Int. J. Radiat. Oncol. Biol. Phys.* 2010 November; 78(3) Suppl: S278.

Parker JN, Zheng X, Luckett W, Markert JM, Cassady KA. Strategies for the rapid construction of conditionally-replicating HSV-1 vectors expressing foreign genes as anticancer therapeutic agents. *Mol Pharm.* 2011 Feb 7;8(1):44-9. Epub 2010 Dec 17. Review. PMID: 21142023

Pearson BE, Markert JM, Fisher WS, Guthrie BL, Fiveash JB, Palmer CA, Riley K. Hitting a moving target: evolution of a treatment paradigm for atypical meningiomas amid changing diagnostic criteria. *Neurosurg Focus.* 2008;24(5):E3. PMID: 18447742

Popple RA, Dieterich S, Duan J, Fiveash JB. Dependence of Dose-volume Values on Calculation Method for Paraspinal Radiosurgery. *Int. J. Radiat. Oncol. Biol. Phys.* 2010 November; 78(3) Suppl: S783.

Popple RA, Fiveash JB, Brezovich IA, Bonner JA: RapidArc radiation therapy: first year experience at the University of Alabama at Birmingham. *Int J Radiat Oncol Biol Phys.* 2010 Jul 1;77(3):932-41.

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 Imagina Radiat Oncol* 2011 Feb;55(1):90-6.

Prendergast Brendan M, Popple Richard A., Clark Grant M., Spencer Sharon A., Guthrie Bart, Markert James, Fiveash John B: Improved clinical efficacy in CNS stereotactic radiosurgery using a flattening filter free linear accelerator. Journal of Radiosurgery and SBRT. Accepted for publication *Journal of Radiosurgery and SBRT,* August 9, 2011. Citation Pending.

Sawrie SM, Fiveash JB. Caudell, JJ: Stereotactic Body Radiation Therapy for Liver Metastases and Primary Hepatocellular Carcinoma: Normal Tissue Tolerances and Toxicity. *Cancer Control* April 2010, Vol. 17, No. 2:111-119

Spencer S, Swaid N, Barton G, Young P, Wong W, Meredith RF, Markert J, Fisher W, Wu X, Nordal R, Fiveash J. Impact of Dose Rate on Outcomes of Gamma Knife Radiosurgery in Patients with Face Pain. *Radiosurgery* 2010 7:360-5.

Sperduto PW, Kased N, Roberge D, Xu Z, Shanley R, Luo X, Sneed PK, Chao ST, Weil RJ, Suh J, Bhatt A, Jensen AW, Brown PD, Shih HA, Kirkpatrick J, Gaspar LE, Fiveash JB, Chiang V, Knisely JPS, Sperduo CM, Lin N, Mehta M: Summary Report on The Graded Prognostic Assessment: An Accurate and Facile Diagnosis-Specific Tool to Estimate Survival for Patients with Brain Metastases. *J Clin Oncol*, 29, 2011.

Sperduto PW, Kased N, Roberge D, Xu Z, Shanley R, Luo X, Sneed PK, Chao ST, Weil RJ, Suh J, Bhatt A, Jensen AW, Brown PD, Shih HA, Kirkpatrick J, Gasper LE, Fiveash JB, Chiang V, Knisely JP, Sperduto CM, Lin N, Mehta M: Effect of Tumor Subtype on Survival and the Graded Prognostic Assessment for Patients with Breast Cancer and Brain Metastases. *Int J Radiat Oncol Biol Phys* 2011, April 14.

Stewart JG, Sawrie SM, Bag A, Han X, Fiveash JB: Management of Brain Metastases. *Current Treatment Options in Neurology.* 2010 Jul;12(4):334-46.

Vaphiades MS, Spencer SA, Riley K, Francis C, Deitz L, Kline LB. Radiation-induced ocular motor cranial nerve palsies in patients with pituitary tumor. *J Neuroophthalmol.* 2011 Sep;31(3):210-3.

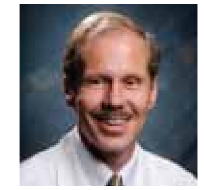
Tours of Excellence

UAB SITE VISITS 2011

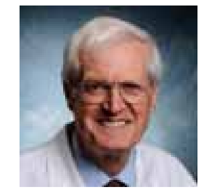
VISITING INSTITUTION	DATE OF VISIT
Gulfport Memorial Hospital – Gulfport, MS	1/31/2011
Rush University – Chicago, IL	2/17/2011
Torrance Memorial Medical Center – Torrance, CA	2/18/2011
University of Kentucky – Lexington, KY	3/24/2011
Memorial Hospital – Chattanooga, TN	4/29/2011
Hospital Israelita Albert Einstein – São Paulo, Brasil	4/12/2011
West Michigan Cancer Center – Kalamazoo, MI	5/6/2011
Corpus Christi Cancer Center – Corpus Christi, TX	5/20/2011
Medical Center at Bowling Green – Bowling Green, KY	6/3/2011
Memorial Hospital – Gulfport, MS	6/9/2011
Eastern Health-Cancer Care Program Dr. H. Bliss Murphy Cancer Centre – NL, Canada	6/16/2011
Baptist Hospital – Miami, FL	7/1/2011
University of Puerto Rico Cancer Center – San Juan, Puerto Rico	8/4/2011 8/5/2011
Vanderbilt University Medical Center – Nashville, TN	8/26/2011
Jackson-Madison County General Hospital – Jackson, TN	9/8/2011 9/9/2011
University of Tennessee Hospital – Knoxville, TN	9/23/2011
Cancer Treatment Centers of America – Tulsa, OK	10/28/2011
Renown Medical Center – Reno, NV	11/11/2011
Radiological Associates of Sacramento – Sacramento, CA	11/18/2011
Hospital Médica Sur – Mexico City, D.F., Mexico	12/9/2011

Partial listing of programs visiting the University of Alabama at Birmingham to learn about treatment techniques on the TrueBeam linear accelerator

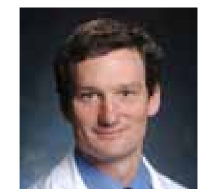
UAB Radiosurgical Clinical Faculty



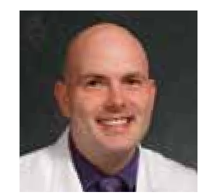
James A. Bonner, MD
Radiation Oncology
Specialties: *lung, head and neck*



Ivan Brezovich, PhD
Medical Physicist
Specialty: *physics*

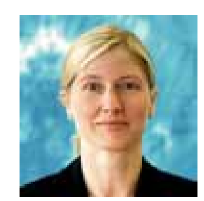


O.L. Burnett III, MD
Radiation Oncology
Specialties: *GU, gynecological, lymphoma, pediatrics, breast, sarcoma, GI*



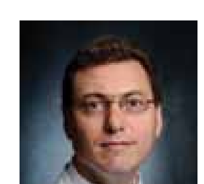
Rex A. Cardan, PhD
Medical Physicist
Specialty: *physics*

Robert Cerfolio, MD
Thoracic Surgery
Specialty: *thorax*



Melissa Chambers, MD
Neurosurgery
Specialties: *brain tumors*

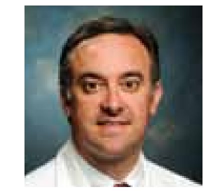
Jennifer De Los Santos, MD
Radiation Oncology
Specialties: *breast, gynecological, lung, lymphoma, sarcoma, skin*



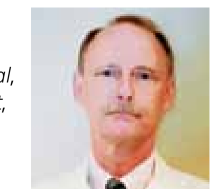
Michael Dobelbower, MD, PhD
Radiation Oncology
Specialties: *benign disease, CNS, GI, GU, head and neck*

Juan Duan, PhD
Medical Physicist
Specialty: *physics*

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



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

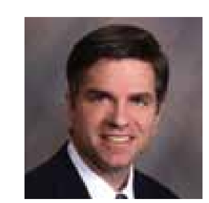


Barton L. Guthrie, MD
Neurosurgery
Specialties: *brain tumors, face pain*

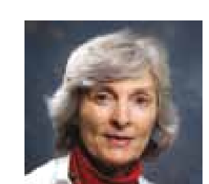
Rojymon Jacob, MD
Radiation Oncology
Specialties: *CNS, GI, GU, sarcoma, benign disease*

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

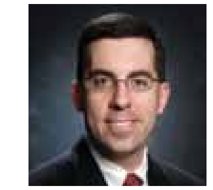
Robert Kim, MD
Radiation Oncology
Specialties: *GU, gynecololgical, ocular melanoma, orbital tumors*



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



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



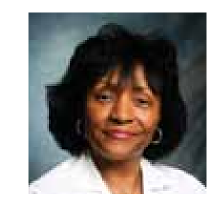
Douglas J. Minnich, MD
Thoracic Oncology
Specialty: *thorax*

Richard Popple, PhD
Medical Physicist
Specialty: *physics*

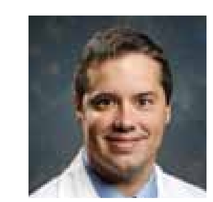
Prem Pareek, PhD
Medical Physicist
Specialty: physics

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

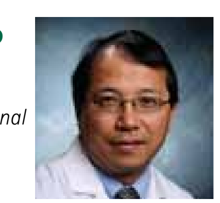
Sui Shen, PhD
Medical Physicist
Specialty: *physics*



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



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



Xingen Wu, PhD
Medical Physicist
Specialty: *physics*

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