#### Washington University School of Medicine Digital Commons@Becker

**Focal Spot Archives** 

Focal Spot

Winter 2007

#### Focal Spot, Winter 2006/2007

Follow this and additional works at: http://digitalcommons.wustl.edu/focal spot archives

**Recommended** Citation

Focal Spot, Winter 2006/2007, January 2007. Bernard Becker Medical Library Archives. Washington University School of Medicine.

This Book is brought to you for free and open access by the Focal Spot at Digital Commons@Becker. It has been accepted for inclusion in Focal Spot Archives by an authorized administrator of Digital Commons@Becker. For more information, please contact engeszer@wustl.edu.

WINTER 2006/2007

VOLUME 37, NUMBER 3

Set

3

2201

20358 5126

T WASHINGTON UNIVERSITY



# Advances in OPTICAL IMAGING

- WOULD YOU LIKE TO HELP RESEARCHERS LEARN MORE ABOUT MEMORY CAPABILITY IN OLDER ADULTS?
- DO YOU HAVE A BROTHER OR SISTER WHO IS WITHIN FOUR YEARS OF YOUR AGE?
- ARE YOU OR YOUR SIBLING BETWEEN THE AGES OF 70 AND 75?

olunteers are needed for a Washington University School of Medicine/Mallinckrodt Institute of Radiology brain imaging study. Both you and your sibling must be able to participate in the study. Note: if you have had a metal device, such as a pacemaker, implanted due to surgery or injury, you may not be eligible for the study.

Eligible volunteers will undergo the following:

- positron emission tomography (PET) scan
- magnetic resonance (MR) scan
- memory assessment

Volunteers will be compensated for their time and participation.

# FOR MORE INFORMATION, CALL **314-362-1558**.

# Contents

FOCAL SPOT WINTER 2006/2007 VOLUME 37, NUMBER 3

#### **IMAGING THE PAST**

Computed tomography-generated three-dimensional models are one of several research techniques that revealed unknown facts about a Saint Louis Science Center mummy.

#### 75 YEARS OF RADIOLOGY EXPERIENCE, PART III

The last of a three-part series about the Institute's 75<sup>th</sup> year as a radiological leader covers 1980 through 2006.





#### NEW WIDE-BORE MRI: AN OPEN AND SHUT CASE

A new magnetic resonance imaging scanner at the Medical Center combines superior, high-field imaging with patient comfort.

14

26

#### 2.....SPOT NEWS



31.....FYI

#### Washington University in St. Louis CHOOL OF MEDICINE

Mallinckrodt Institute

Visit the MIR web site at www.mir.wustl.edu

#### Optical Imaging Laboratory researchers are focusing on new molecularly targeted probes and strategies to provide diagnostic information and therapeutic response.

#### **RSNA: STRENGTHENING PROFESSIONALISM**

**ADVANCES IN OPTICAL IMAGING** 

Institute faculty and staff were among those participating in the 92<sup>nd</sup> annual meeting that included the inauguration of MIR's Gilbert Jost, MD, as the 2007 RSNA president.

#### TAKING MAMMOGRAPHY SCREENING ON THE ROAD

After two decades of taking affordable, high-quality breast-cancer screening to workplaces and neighborhoods, the latest mobile unit is equipped with digital technology.

#### 3D/4D: CHANGING THE POWER OF ULTRASOUND

Real-time, 3-D ultrasound, coupled with the fourth dimension of time, offers shorter exam times, data manipulation, and tumor volume tracking during treatment.

ON THE COVER Samuel Achilefu, PhD, envisions a time when the use of optical imaging will have a major clinical impact by determining the functional state of tissue. Photograph by Tim Parker.





# SPOT NEWS

#### Journal honors editors and reviewers

In the January 2007 issue of *Radiology*, the Editorial Board recognized the appointment of new associate editors and consultants to the editors. That same issue acknowledged those reviewers who consistently provide prompt, detailed, high quality, and scholarly reviews. Among those honored were these MIR faculty.

- Louis Gilula, MD, professor of radiology, of orthopaedic surgery, and of plastic and reconstructive surgery appointed associate editor and recipient of the Editor's Recognition Award with Special Distinction
- Marilyn Siegel, MD, professor of radiology and of pediatrics—recipient of the Editor's Recognition Award with Distinction
- Suresh Vedantham, MD, associate professor of radiology and of surgery recipient of the Editor's Recognition Award with Distinction.

Also recognized was Christopher Moran, MD, professor of radiology and of neurological surgery, upon the completion of his membership on the *Radiology* Editorial Board.

#### Bhalla heads thoracic imaging

In January 2007, Sanjeev Bhalla, MD, assistant professor of radiology, was named chief of thoracic imaging. He assumes the leadership position held for more than 30 years by Stuart Sagel, MD, professor of radiology. Sagel recently relinquished administrative responsibilities so he could devote more time to clinical duties.



Bhalla came to Mallinckrodt Institute in 1995 as a first-year diagnostic radiology resident (chief resident, 1998-1999) and later completed a thoracic imaging fellowship. He joined the Institute faculty in 2000 and has been actively involved in resident education, currently serving as an assistant director of the Diagnostic Radiology Residency Program.

Bhalla is nationally known for his expertise in computed tomography (CT) and, with Christine Menias, MD, heads the Institute's body CT service. He is a faculty member of the Washington University Hereditary Hemorrhagic Telegiectasia (HHT) Center, the second largest HHT center in the United States. HHT is a rare, inherited disorder of the blood vessels, and Bhalla is investigating the diagnostic effectiveness of CT with three-dimensional reconstruction capability to detect pulmonary arteriovenous malformations in patients with HHT.

#### Research development yields partnership

Research begun in Mallinckrodt Institute's **Optical Radiology Laboratory** (ORL) in 2004 focused on studying brain function, angiogenesis, and protein expression in tumors as well as metastases. Working with high-resolution optical imaging, Joseph Culver, PhD, assisted by other ORL researchers, developed a high-density diffuse optical tomography (DOT) system that can measure blood movement and oxygen levels in the brain.

The Washington University Office of Technology Management, which facilitates the transfer of early-stage, University-developed technology to private companies "for the benefit of society while generating income to support research and education," has teamed with an investment company to develop a start-up optical imaging technology firm. Culver, an assistant professor of radiology, will oversee DOT development for use in neonatal intensive care units. Clinical trials will show whether DOT is effective in detecting brain damage or trauma and therapy response.

#### MRI services are ACR accredited

The American College of Radiology (ACR) has issued a three-year accreditation for the magnetic resonance imaging (MRI) services provided by Mallinckrodt Institute at Washington University Medical Center. ACR accreditation is awarded based on a rigorous evaluation of personnel and equipment by board-certified physicians and medical physicists who are experts in a specific field. Accreditation demonstrates commitment to quality patient care and is recognized by many insurance companies and healthcare programs as a valuable asset for a medical provider.

The ACR—a national organization of diagnostic and interventional radiologists, radiation oncologists, and medical physicists—has accredited programs for MRI, ultrasound, nuclear medicine, positron emission tomography, computed tomography, stereotactic breast biopsy, and radiation oncology.

#### IR ce 20 an

tiona

one

com

the o

on F

the v

reso

dire

IR se

Dan

rent

of M

a wi

guid

targ

offe

less

to s

incl

onc

angi

sucl

ster

radi

clin

con

care

pro

#### IR service celebrates 20th anniversary

cal

is

ous

d

ied

s in

ion

is

nce

set

as

on

m

The Institute's interventional radiology (IR) service, one of the largest and most comprehensive facilities in the country, was established on February 14, 1987, to lend the weight of the Institute's resources to the changing direction of radiology. The IR service, founded by Daniel Picus, MD, and currently under the leadership of Michael Darcy, MD, offers a wide array of imageguided, minimally invasive, targeted treatments that offer less risk, less pain, and less recovery time as compared to surgery. These procedures include fibroid embolization, oncologic interventions, and angiographic procedures such as angioplasty and stenting. Interventional radiologists also provide the clinical care-both initial consultations and follow-up care-associated with these procedures.

MIR provides technical support

The eighth annual Integrating the Healthcare Enterprise (IHE) North America Connectathon drew representatives from 80 companies and organizations to its January meeting in Chicago. And for the eighth year, Mallinckrodt Institute provided the event's technical management-most notably through the leadership of Stephen Moore, MS, a research assistant professor in the Electronic Radiology Laboratory (ERL).

Sponsored by the Radiological Society of North America, the American College of Cardiology, and

Healthcare Information and Management Systems Society, the IHE Connectathon provides an important venue for vendors to test their products' ability to communicate with competitors' products. During the weeklong event, major diagnostic medicalimaging vendors as well as vendors of Electronic Health Record systems worked together to test their systems as they scheduled, acquired, and archived imaging studies electronically; shared radiology and other reports between departments; and exchanged health record data at the hospital and regional levels. These vendors are cooperating with United States government initiatives that will provide caregivers with better and timely access to health records, even as

patients change physicians or move to different areas of the country.

.....

Moore, who joined the ERL in 1987, has been involved in the Digital Imaging and Communications in Medicine standard since the first version was developed in 1993. He is well-known for developing software tools for managing data collection for clinical trials and for developing test tools for the IHE Technical Frameworks.



Workers are building the interior walls of the Institute's Center for Clinical Imaging Research. The bioimaging facility for basic and translational inpatient and outpatient clinical research is slated to open in May 2007.



# IMAGING THE PAST NO CURSE FOR THIS MUMMY



by Vicki Kunkler



eople from around the world have long had a fascination with mummies. If you have ever watched late-night horror films on television, you

probably are familiar with actors Boris Karloff or Lon Chaney in *The Mummy* or *The Mummy's Ghost.* Perhaps the best known mummies are those from Egypt, such as Nebkheperure Tutankhamun, Rameses II, or Seti I. But records of mummies have been found in numerous countries, including the bog bodies in Ireland, the Netherlands, and Germany; Incan mummies in Peru; Aztec mummies in Mexico; and Buddhist mummies in Japan. And St. Louis has its very own mummy—soon to be part of an exhibit at the Saint Louis Science Center (SLSC).

The mummified child—part of a private collection donated in 1985 to the SLSC—made its "debut" in the Summer/Fall 2005 issue of *Focal Spot* magazine. At the time, little was known about the mummy's history. So, the artifact was brought to Washington University Medical Center for computed tomography (CT) scanning, a process that would reveal some of the mummy's mysteries without causing any physical damage to the wrappings and the body. Since that time, a team of researchers have used CT-generated three-dimensional models, DNA testing, and radiocarbon dating to study every aspect of the mummy.

On March 15, you will be able to see firsthand the findings from those intense studies: the mummy will be featured in his (yes, it's a boy!) own exhibit, which coincides with the showing of an OMNIMAX® film about—you guessed it—mummies. For the record, the film's title is *Mummies: Secrets of the Pharaohs*. On May 17, some of the research team will present "The Mystery of the Mummy" as part of the SLSC's Science Café: "stimulating conversation in an informal setting." For more information about this exhibit and other exciting programs at the Science Center, visit www.slsc.org.

Left: Rendering (looking front to back) of the mummy skeleton, which was created by using more than 1,000 slices obtained from high-resolution whole-body computed tomography (CT) data. Most of the wrappings covering the mummy and soft tissues remaining on the body have been made transparent. The anterior fontanelle and open cranial sutures indicate the mummy is a child.

Above: Samples of the wrappings (an estimated eight layers of linen plus a large shroud) were used for radiocarbon dating.

### RESEARCH TEAM

The American University in Cairo (Egypt) Salima Ikram, PhD: Egyptologist and mummy specialist

Barnes-Jewish Hospital Christopher Tincher, RT: radiology technologist and clinical instructor, CT

Florida State University Dean Falk, PhD: anthropologist

Mallinckrodt Institute of Radiology Charles Hildebolt, DDS, PhD: dentist and anthropologist Kirk Smith: senior research engineer Steven Don, MD: pediatric radiologist

The Metropolitan Museum of Art (New York City) Emilia Cortés: conservator, textile conservation

Saint Louis Science Center Melinda Frillman: collections manager Al Wiman: vice president for public understanding of science

Washington University in St. Louis School of Medicine Anne Bowcock, PhD: geneticist Li Cao, MD: geneticist



Core samples were taken from the mummy for DNA testing. (Left to right) Researchers Charles Hildebolt, Li Cao, and Anne Bowcock.

#### 75 Years of Radiology **Experience**, Part III

The following article (the last in a Years of Radiolog three-part series) focuses on the past three decadesyears that included the challenge of installing an all-digital department, expanding research initiatives, improving patient care, and strengthening an already excellent program.

Mallinckrodt Institute of Radiology alread (Information for this three-part history of MIR was condensed from several sources, including the booklet Mallinckrodt Institute of Radiology 50th Anniversary and an informal text prepared by Sam Merenda, MD, a St. Louis radiologist.)

#### 1980s

#### 1980

- The Institute opens "condominium-style" clinical areas in the Barnes Hospital West Pavilion: on the 10<sup>th</sup> floor, a complete outpatient facility; on the 9th floor, a wellequipped cardiac catheterization suite plus Division of Nuclear Medicine clinical and administrative areas.
- MIR designs its own electronic media system called Mallinckrodt Institute of Radiology-Digital Image Processing System, or MIR-DIPS, to support the interface between a Picker 80L-D1 ultrasound scanner and a digital minicomputer.
- Real-time echoencephalography is developed to detect evidence of intracranial hemorrhage, especially in premature infants.
- A fluorescent-activated cell sorter (called flow cytometry) is installed in the Division of Radiation Oncology's new facility on Forest Park Boulevard. The technology applies the most recent advances in electronics and laser technology to basic problems of cell and tumor biology.
- Interventional radiology procedures are begun at the Institute, including angioplasty, local thrombolytic therapy, transcatheter arterial embolization, and transhepatic biliary drainage
- · Diagnostic computer optical reading techniques are used to track patients' progress through the Institute.

• Cancer biology researchers in the Division of Radiation Oncology develop a new technique for simplifying the identification of hormone-responsive tumors and improving the reliability of previous assay procedures.

#### 1981

- MIR celebrates its 50<sup>th</sup> anniversary.
- PETT IV, latest in the line of PETT systems developed and used at the Institute, provides seven image slices of the brain simultaneously to achieve quantitative regional metabolic and hemodynamic measurements.
- Later in the year, Super PETT is designed and built at the Institute, providing accurately defined distribution patterns of short-lived, positron-emitting radioactive isotopes.
- MIR radiologists are involved in the design and development of digital fluoroscopy, new imaging technology that links a computer and associated electronics to conventional fluoroscopic equipment.

#### 1982

- To accommodate the growing use of ultrasound, the diagnostic ultrasound lab is moved from 3 West Pavilion into renovated space on the Institute's fourth floor.
- MIR researchers develop three-dimensional computed tomography (CT) image processing for a more effective diagnosis and treatment planning.

#### 1983

- As part of a collaborative clinical research program with Siemens Corporation of West Germany, the first nuclear magnetic resonance (NMR) imaging scanner is housed in a new facility on MIR's fifth floor.
- Nearly half of all radiation therapy in the St. Louis area is administered by MIR's Division of Radiation Oncology. To accommodate expanding clinical needs, the ground floor facility is renovated, using 210 tons of steel to form the ceilings and walls.
- Radiation oncology receives a Clinac 6 linear accelerator that produces sharply defined radiation beams.
- The Division of Radiation Oncology opens the Hyperthermia Treatment and Research Center-the first in the Midwest and one of the most advanced centers in the United States.
- An MIR researcher and a Washington University School of Medicine (WUSM) plastic surgeon develop methods to produce life-size models of the skull, using contours derived from CT scans that are converted to a three-dimensional form. The technology significantly changes the approach used for diagnosis and treatment of complex craniofacial abnormalities.
- Neurologists affiliated with the Division of Radiation Sciences develop a quantitative method to produce anatomical localization with positron emission tomography (PET) images. Called stereotactic localization, the method pinpoints brain disorders such as Parkinson disease and panic disorder.

#### 1984

- A second NMR scanner is installed at the Institute
- As part of a technology exchange program for applying advanced engineering technology to the solution of medical problems, MIR researchers can map the human body, using NASA's satellite imaging technology to recognize and color-code types of tissue contained in a cross-sectional NMR scan.
- MIR research facilities are now on the fourth and fifth floors of the Clinical Sciences and Research Building and on three floors of the East Building.

- The Institute's third MRI scanner, the first 1.5 Tesla superconductive magnet in the United States, is installed in the East Building research area.
- A pilot study uses nuclear medicine as a proving ground for a fully digital clinical operation at the Institute.
- MIR radiologists partner with WUSM urologists to use percutaneous nephrolithotomy, in conjunction with Barnes Hospital's lithotripter, to remove renal and ureteral stones.
- MIR radiologists and Washington University anthropologists use 3-D CT to image fossil skulls embedded in stone, producing precise measurement of brain size and shape. The research is hailed as a breakthrough in the paleontological study of fossil skulls.

#### 1985

- Ronald Evens, MD, is named president and CEO of St. Louis Children's Hospital, while retaining his position as director of Mallinckrodt Institute.
- Gilbert Jost, MD, head of the diagnostic computer group, is appointed the Institute's first chief of the Division of Diagnostic Radiology.
- MIR's expertise in computers and information networking helps to lay the groundwork for the Washington University campus network of computing and information resources. The system is fully functional by 1988.
- MIR provides state-of-the-art X-ray equipment for the new Barnes Hospital Emergency Department, a joint venture of Barnes Hospital and WUSM.

#### 1986

- The Electronic Radiology Laboratory (ERL), housed in the East Building, is established to investigate digital imaging technologies.
- MIR is on the move as renovations are completed on the ninth and tenth floor (administrative offices); seventh floor (nuclear medicine Clinical PET Center); and fifth floor (site of an MRI scanner and two new CT scanners).

- MIR launches the first mobile mammography unit in the Midwest, providing convenient, high quality, affordable, breast-cancer screening.
- Division of Radiation Oncology receives a Clinac 1800 linear accelerator, which provides the most accurate and effective method of therapeutic radiation available for cancer treatment.

#### 1987

- The Interventional Radiology Section is established at the Institute.
- MIR installs the Phillips Computed Radiography system, which is the first viable means for capturing and displaying conventional radiographic images digitally without having to significantly alter existing procedures and equipment.
- MIR enters partnership with St. Louis Regional Health Care to provide free mammography screening through the Mobile Mammography Program for Regional's five clinics.
- Because of its international research reputation, MIR receives the nation's first Lithostar, a new system for treating kidney stones by using shock waves.
- MIR opens a mammography screening facility (a first-of-its-kind healthcare center) at St. Louis Centre, the largest, enclosed urban shopping mall in the United States.

#### 1988

- In a collaborative study, MIR scientists create PET images of estrogen receptors in women with breast cancer. The resulting PET image is the Society of Nuclear Medicine's "Image of the Year for 1987."
- Radiation oncology physicists develop a precise, three-dimensional treatment planning system for cancer.
- Radiation oncology scientists develop a prototype on-line imager (called On-Line Image Verification) that electronically plots the target of the radiation beam as treatment occurs.

#### 1990s

#### 1990

- MIR uses the Picture Archiving and Communication System (one of only two such systems in the United States) developed by Siemens Corporation to evaluate magnetic resonance imaging with eight separate TV monitors that closely view and manipulate each image and then focus on the specific characteristics of each image.
- Researchers from Washington University and the ERL collaborate with Southwestern Bell Telephone on the Fast-Packet Project, a high-speed, fiber-optic communication system capable of transmitting voice, data, video, and high-resolution images.

#### 1991

- MIR and the WUSM Department of Internal Medicine collaborate on a research study using PET to measure metabolic activity in relation to blood flow in damaged heart muscle. Preliminary data show the heart's ability to metabolize oxygen is an important factor in determining if the heart muscle will remain viable.
- MIR and the WUSM Plastic and Reconstructive Surgery group collaborate with a St. Louis company to convert an existing sensing device into a medical facial scanner for use in planning reconstructive surgery techniques. MIR later provides images to MGM studios for operating-room scenes in the psychological thriller *Shattered*.
- MIR's Radiation Oncology Center (as the Division is now called) opens the St. Louis area's first 3-D Treatment Planning Center for cancer, which uses an existing CT scanner equipped with a special laser-marking system and connected to a 3-D treatment planning computer to target hard-to-treat cancer sites.
- Expansion of the Institute's Diagnostic Radiology Residency Program includes a one-year Research Residency Program that combines the science of medicine and the clinical application of radiology.

*Years of Radiology* Mallinckrodt Institute of Radiology

#### 1992

- Barnes Hospital and Washington University renew their affiliation through a new 15-year contract. The hospital now has responsibility for the Institute's technical operation; physician services and responsibility for all research conducted at MIR remains with the Institute.
- MIR opens a neurointerventional suite, with the St. Louis area's only trained neurointerventional radiologist.
- The ERL research group develops software to be used at the Radiological Society of North America's Annual Meeting to demonstrate the viability of the Digital Imaging and Communication (DICOM) Standard—a protocol to be followed by medical equipment manufacturers for the formatting and exchange of electronic images.
- A newer version of the mammography mobile, sponsored by Barnes Hospital in conjunction with MIR, makes its debut.

#### 1993

- Researchers at MIR and at the Science
  Research Laboratory parlay the technology
  behind an anti-missile gun developed under
  the United States defense system's Star
  Wars program into a new breed of linear
  accelerator called the Tandem Cascade
  Accelerator (TCA). MIR is the only medical
  institution equipped with two dedicated
  cyclotrons and a TCA for the production of
  radiopharmaceuticals used in PET studies.
- MIR assists Austrian scientists in producing 3-D reconstructions of the internationally known Iceman, the oldest, most wellpreserved, intact body ever found.
- Barnes Hospital and the Jewish Hospital of St. Louis merge to form Barnes/Jewish Inc., and MIR is asked to consolidatie radiology services between the two hospitals.
- MIR's Breast Imaging Section is established.

#### 1994

• With the dedication of the Mallinckrodt Institute of Radiology at Washington Imaging Center, MIR has the only facility worldwide where scientists conduct PET and MRI research for application to medical problems in a centralized location. • The merger of the diagnostic radiology residency programs at Barnes and Jewish hospitals results in MIR's 68-member training program, the largest of its kind in the United States.

#### 1996

- MIR researchers are involved in the first, multicenter study to evaluate the effectiveness of PET scans in cancer diagnosis.
- Scientists develop a retrospective respiratory-gating technique to decrease or eliminate respiratory motion during coronary artery imaging using MRI.

#### 1997

• Interventional radiologists and vascular surgeons test an endovascular device that may revolutionize the repair of abdominal aortic aneurysms.

#### 1998

- Research using rapid prototyping technology translates CT or MRI data into 3-D models that provide surgeons with critical preoperative information for hip joint replacement. MIR is one of three facilities nationwide with the equipment and software for making detailed physical copies of a targeted body part.
- The newest MRI platform for cardiovascular imaging ("The Symphony"), installed in the East Building research facility, is vital to the Institute's cardiovascular MRI program.
- Collaborative research uses tamoxifen, the most commonly prescribed anti-cancer agent, and PET to predict within two weeks if the initiation of advanced breast cancer treatment will work. The breakthrough research enables patients who do not respond to tamoxifen therapy to quickly pursue other treatment options.

#### 1999

- Directors of the Institute and the High Energy Medical Research Center at Fukui Medical University (Japan) sign a five-year academic exchange and cooperation agreement for joint research activities.
- Ronald Evens, MD, director of the Institute, accepts the position of president of Barnes-Jewish Hospital (BJH). Gilbert Jost, MD, chief of the Division of Diagnostic Radiology, is named interim director.

#### THE NEW MILLENNIUM

#### 2000

- MIR neuroradiologists are involved in a multi-institutional, first-of-its-kind study using MRI to track normal development in a child's brain.
- Interventional radiologists, vascular and cardiothoracic surgeons, and cardiologists combine radiological and endovascular techniques to provide a revolutionary, minimally invasive treatment for patients with thoracic aortic dissection.
- The Institute receives two of the nation's first In Vivo MAGNITUDE® MRI-compatible digital monitoring systems to be used for neurological and cardiac imaging research in the East Building.
- MIR receives the nation's first Optistar<sup>TM</sup> magnetic resonance contrast power injector, a delivery system that provides controlled, efficient, and fast delivery of contrast media in gadolinium-enhanced anatomical imaging and in bolus-enhanced perfusion studies of the brain and heart.

- After an extensive nationwide search, Gilbert Jost, MD is named chairman of the WUSM Department of Radiology and director of the Institute. Daniel Picus, MD, succeeds Jost as chief of the Division of Diagnostic Radiology.
- MIR's Radiology Oncology Center becomes a separate Department of Radiation Oncology, with Carlos Perez, MD as department chairman.
- The Advanced Center for Medicine opens, providing convenient, multidisciplinary care (including radiology and nuclear medicine services) for ambulatory patients.
- The Alvin J. Siteman Cancer Center (SCC) officially opens. Housed in the Center for Advanced Medicine, SCC is the only cancer facility in Missouri to earn national recognition as an NCI-designated cancer center.
- MIR partners with Tyco Healthcare to manufacture and distribute F-18 fluorodeoxyglucose (FDG), a radiopharmaceutical used in PET studies of the brain, heart, and cancer.

• An MIR researcher's decade-long study of clinical depression shows that anomalies in the brain's serotonin system are important in setting the stage for depression, discoveries that also can impact treatment of other conditions such as Parkinson disease and epilepsy.

#### 2002

- A \$10 million NCI grant funds the Institute's Molecular Imaging Center, one of five in the United States.
- Using functional MRI to study actor/director Christopher Reeves's unprecedented recovery of partial movement following spinal cord injury, MRI researchers discover that even a pattern of damage within the spinal cord does not necessarily mean a patient cannot recover any function, given the right stimulation.
- The Institute will provide diagnostic radiology services for the recently opened, 52,000 square-foot Charles F. Knight Emergency and Trauma Center.
- With more than a century of collective experience, the Institute's nuclear medicine physicians in the Clinical PET Center now have the added advantage of the St. Louis area's only PET/CT scanner to aid in the detection and localization of disease.
- MIR's interventional radiology service is the only group in the St. Louis area to offer a comprehensive approach to cancer therapy using both vascular and nonvascular intervention—chemoembolization and radiofrequency ablation—for patients with liver cancer.

#### 2003

- Neuroradiologists test a magnetic guidance system called Telstar, the latest refinement in the fast growing field of endovascular surgery in the treatment of brain aneurysms.
- MIR participates in the multi-institutional National Lung Screening Trial, part of a nationwide NCI effort to determine whether lung cancer deaths can be reduced by early intervention with standard X rays or spiral CT before symptoms appear.

- Researchers in the Biomedical MR Laboratory are devising a method for determining injury to the myelin sheath around nerves, which could have a profound impact on predicting the future course of multiple sclerosis and other neurodegenerative disease.
- MIR participates in a nationwide NCI clinical trial called DMIST (Digital Mammographic Imaging Screening Trial) to determine whether digital mammography is as effective as or better than standard film-based mammography in the early detection of breast cancer.
- Washington University announces BioMed 21, a 10-year initiative for developing a multidisciplinary approach to basic and clinical research. MIR's seven decades of experience will be evident in the Center for Biological Imaging, a facility for studying the molecular interactions that underlie cellular and genetic processes.

#### 2004

- A massive, ultra-high field (11.75 Tesla) magnetic resonance scanner is installed in the Scott Avenue Imaging Center.
- MIR announces the renovation of facilities on 10 West Pavilion to house a Center for Clinical Imaging Research, which will emphasize clinical translational research projects ultimately leading to better diagnosis and management of disease and improved patient therapy.
- Researchers use new CT diagnostic imaging to study the nearly complete skeleton (called Hobbit or LB1) discovered in 2003 in the Indonesian islands of Flores. Hobbit is considered by many scientists as the most important discovery for studying human evolution since the 1924 Taung Baby.
- Renovations begin on 10 West Pavilion the future site of the Center for Clinical Imaging Research, a bioimaging facility with advanced imaging resources and clinical investigators from numerous Washington University departments.

#### 2005

- MIR earns top spot in National Institutes of Health (NIH) funding of radiology departments: 53 total awards totaling \$26.1 million.
- Interventional radiologists test the viability of a physics-based angiographic simulator for radiology resident training. The unit offers a well-controlled, ionizing radiationfree environment for practicing catheter and guidewire techniques used in endovascular therapy cases performed by interventional radiologists.
- Meet Marvin, an Optimized Robot for Chemical Analyses—the linchpin of the new High-Throughput Screening Core of the Molecular Imaging Center.

- Efforts of physician advocates, including an MIR nuclear medicine physician, result in the National Oncologic PET Registry, which compiles data from participating medical centers using PET imaging for patients with cancer and assesses the impact of PET on patient management.
- As part of the National CT Colonography Trial, MIR researchers evaluate new noninvasive technologies to make colon cancer screening easier, faster, and more comfortable for the patient while providing diagnostic accuracy.
- Researchers participate in a landmark international study (Silent Infarct Transfusion or SIT) to evaluate the effectiveness of blood transfusion therapy in preventing strokes in children with sickle cell disease. Thousands of magnetic resonance images generated for the study are processed by a system devised in the Institute's ERL.
- For the second consecutive year, the Institute is the top radiology department in regard to NIH funding: 57 awards for a total of \$28.9 million.
- A new MRI scanner, the 3.0 Tesla MAGENTOM Trio with TIM, is used for whole body imaging in the Scott Avenue Imaging Center.

# New wide-bore MRI: by Anne Kessen Lowell an open and shut Case

Imagine needing a crucial radiological exam to diagnose a serious medical condition. The test is noninvasive, widely used, and boasts pinpoint accuracy. Its findings could be the first step in treatment—perhaps even saving your life. Now imagine that this exam is not available because you cannot fit into the medical equipment. So, you have to settle for a less accurate type of exam or face an invasive procedure, perhaps even surgery.



Espree

Until recently, millions of people who needed a magnetic resonance imaging (MRI, also called MR) exam faced this predicament. Bariatric (obese) patients cannot use the conventional or "closed" MRI scanners. and people with claustrophobia (fear of enclosed or confined spaces) find it impossible to complete the exam—if they can even overcome the dread of entering the long tube, or bore, of the machine. The arrival of a new wide-bore Ø machine at Washing-COUC ton University Medical Center will literally open up MRI testing-with its



Jeffrey Brown, MD (seated) and Vamsidhar Narra, MD, are chiefs of the Institute's body MRI service.

(Left) The MAGNETOM Espree scanner. Photo courtesy of Siemens Medical Solutions

remarkable images and diagnostic capability—to everyone who comes to Barnes-Jewish Hospital (BJH). The new MAGNETOM Espree<sup>™</sup>, a 1.5T system manufactured by Siemens Medical Solutions and scheduled for installation in the Center for Advanced Medicine during the first quarter of 2007, will be BJH's second such unit, joining the Espree currently in use at Barnes-Jewish West County Hospital (BJWCH). Vamsidhar Narra, MD, associate professor of radiology, plans a hearty welcome for the new equipment. "So many patients are unable to complete an MRI exam in the conventional machine due to claustrophobia," he laments. "Perhaps fifteen to twenty percent of the time our patients simply cannot complete the exam; they can't remain still or they feel they have to get out of the scanner."

"The Espree is ten centimeters larger in diameter and almost a meter shorter in length than the standard MRI scanner," he adds. "In addition, the table mechanism is built to accommodate more weight. Before the development of this new machine, we had to turn patients away if they weighed more than three hundred fifty pounds. Now, with a weight limit of five hundred fifty pounds, we will be able to offer the benefits of MRI imaging to almost everyone."

The new, wide-bore MRI scanner combines added patient comfort with the superior high-field imaging that radiologists count on to do their work. "This scanner provides excellent images of the blood vessels in the abdomen and legs," Narra adds.

#### **Tech Talk**

MD, are

MRI machines, like the 13 clinical and research units in use at Mallinckrodt Institute and Barnes-Jewish Hospital, combine principles of physics, biology, and mathematics to produce intricately detailed two-dimensional (2-D) and threedimensional (3-D) images of the human body. MRI's ability to "see" inside the body is especially valuable in neurological and arterial exams. Neurological MRI studies can localize an individual's language and motor centers in the brain, giving surgeons necessary information for procedure planning. In cardiac imaging, MRI provides a 3-D picture of blood vessels to be used in the detection of coronary artery disease. But MRI equipment requires many components to work its magic.

The most recognizable feature of an MRI scanner is the bore, or cylindrical tube, into which the patient slides on a mechanized table for the exam. The features of the bore that make it intimidating to some patients and limit its capacity are the inside diameter of the hole and the length of the tube. The bore combines a powerful magnet with radio-frequency pulsation to produce a pictorial representation of normal and abnormal

The roomy Espree scanner can accommodate larger patients and is patient-friendly for those with claustrophobia. Photo courtesy of Siemens Medical Solutions.

cells and tissue. The second ingredient that accounts for the bore's size is two sets of magnetic coils: the body coil and the gradient coil that are wrapped around the bore.

The magnetic field employed by MRI is measured in Tesla (named for Nikola Tesla, the 19<sup>th</sup> century

#### MRI services performed at Washington University Medical Center

- Imaging of the liver for patients with cirrhosis
- Imaging of patients in the liver transplantation program
- Imaging of the pancreas, kidneys, and adrenal glands
- Magnetic resonance cholangiopancreatography (MCRP) assessment of the biliary tract, including the bile and pancreatic ducts and the gallbladder
- MR urography—imaging the kidneys, ureters, and bladder
- Imaging the prostate gland (using an endorectal coil)

- Imaging the female urethra (using an endovaginal coil) in women with incontinence
- Breast MRI—for assessment of cancer and for the evaluation of implant rupture
- Cardiac MRI—examining for congenital heart disease and mass lesions; evaluating the heart's function; assessing areas of infarction
- MR angiography and venography—studying various blood vessels (arteries and veins)
- Imaging of the small bowel for patient's with Crohn's disease



#### NMR comes to MIR

Nuclear magnetic resonance (NMR) imaging—as magnetic resonance imaging (MRI) was first called—arrived at Mallinckrodt Institute of Radiology (MIR) in the summer of 1983; the scanner was one of the first in Missouri. A news release dated December 21, 1983, announced that "Mallinckrodt is among an elite group of fewer than 25 medical institutions in the country able to provide patients with the benefit of an NMR examination." NMR was hailed as "the most important diagnostic imaging method for the 1980s and beyond, offering the greatest opportunities for physicians' earlier, accurate diagnoses of diseases not easily seen by other imaging tests."

That first scanner, manufactured by Siemens Corporation of West Germany, weighed 12,000 pounds and was housed in a new 5,000 square-foot addition to the Institute. A team of MIR clinicians and scientists (including Ronald Evens, MD; Mokhtar Gado, MD; Joseph Lee, MD; William Murphy, MD; and Michel Ter-Pogossian, PhD) conducted approximately 500 studies to assess NMR's capabilities and diagnostic potential before the technology was applied to clinical use in early 1984. The Institute was quickly established as a leader in research and clinical NMR applications. A second scanner was in place and operating in March 1984.

Research performed at the Institute has played an important role in developing new MRI techniques. In these applications, MR imaging has contributed to the detection and characterization of disease and to the monitoring of abnormalities following treatment.

The 1984 NMR scanner.





scientist who pioneered research in the properties of magnetic fields). A 1.5 Tesla magnet is most commonly used in MRI for its speed, exceptional imaging quality, and level of detail. The junkyard magnet that got rid of your grandfather's Buick measures up to the MRI magnet in strength, at 1.5 Tesla. By comparison, the earth's gravitational pull is one ten-thousandth of one Tesla.

In the mid 1990s, the industry introduced an "open" MRI with access on three sides. But, as Narra points out, its magnet strength, only 0.2 to 0.3 Tesla, did not measure up. "Although the equipment was more comfortable for the patient, the field strength was very low. At that level you just can't get good images. For years medical equipment engineers have been working to improve the technology. We finally have that technology, joined with patient comfort, in the wide-bore MRI high-field imaging scanner."

Two technological advances resulted in the roomier MRI machine. First, engineers at Siemens Medical Solutions developed a magnet that is more compact but does not sacrifice any field strength. The Espree's magnet is 125 centimeters long, nearly half the length of the older MRI units. Second, proprietary technology allowed Siemens to compress the body coil and gradient coil into a smaller area and increase the width of the bore by almost twenty percent, to 70 centimeters in diameter. Now patients will not feel as if they are "nose-to-the-magnet" and will have a comfortable amount of elbowroom.

Tammie Benzinger, MD, and David Rubin, MD, chief of MIR's musculoskeletal radiology section, are in the Espree scanner control room at BJWCH.

In addition to more space within the bore and a stronger table mechanism, the Espree brings other advantages over conventional MRI scanners. New technology in the coils allows rapid screening of multiple areas of the body without

repositioning. In conventional scanners, imaging more than one part of the body requires stopping the exam, repositioning the patient, and restarting. Now a body scan can be completed in about 12 minutes, without interruption, as compared to the 15 minutes to 45 minutes required for a conventional MRI scanner.

Second, in most exams, patients can enter the Espree's bore feetfirst rather than headfirst. Because of the bore's shorter length, the patient's head remains outside the scanner for most exams. In conventional MRI scanners, the patient's nose would be almost touching the top of the tube.

Third, in-patient exams will be done with greater ease and comfort. The wide-bore scanner can accommodate critically ill patients who are intubated or who are connected to other tubes and lines.



Nancy Genetti, RT(R), is the BJH technical supervisor for the MRI service.



Narra and Brown in the MRI reading room in the Center for Advanced Medicine.

The fourth and most significant procedural advantage of the wide-bore technology is the ability to perform *in situ* breast biopsies immediately following an MRI scan. Patients remain comfortably lying on their stomachs while the scan is done; then a radiologist who specializes in breast imaging performs a precisionguided biopsy of suspect tissue, resulting in greater patient comfort and faster diagnosis.

#### **Breathing Room**

As one of the estimated 15 million Americans with severe claustrophobia, Debbie Mattingly can attest to the advantages of the wide-bore MRI over the conventional type. Mattingly, who works in a private practice medical office at BJWCH, has undergone MRI exams in all three types of equipment. She gives the wide-bore scanner her vote. "In the closed *[conventional MRI]*, I can feel it *[the bore]* on my arms, and that's when I panic. In the open MRI, I felt bolted down. The widebore is large enough that I don't even feel the machine. It seems to me that it was faster, too." Even though Mattingly still required some sedation during the wide-bore MRI exam based on her previous experiences in the other types of equipment—she says of the wide-bore MRI, "It is a fabulous improvement."

The wide-bore MRI will vastly enhance the diagnosis and treatment of obesity-related conditions. Overweight individuals are often among those most in need of the diagnostic power of an MRI exam. The litany of serious and potentially dangerous medical problems arising from obesity includes cardiovascular disease, diabetes, cancer, knee problems, and lumbar disk herniation. MR imagery offers the best method of evaluation and diagnosis for large patients. Ultrasound does not pick up clear images through large amounts of body fat; computed tomography

scanners and conventional MRI scanners cannot support patient weight in excess of 350 pounds. Unfortunately, obesity in the United States continues to threaten the population's health and well-being. An estimated one fourth of the patients admitted to Barnes-Jewish Hospital weigh more than 350 pounds. Now they will have access to MRI's life-saving technology.

For anyone suffering from claustrophobia, for bariatric individuals, for in-patient exams, and for patients seeking a more comfortable and faster evaluation of a suspect breast mass, the wide-bore MRI scanner at Washington University Medical Center will soon be open for business.

# <section-header><section-header><text><text>

computed tomography (CT), or positron emission tomography (PET)—often play a key role in helping the physician evaluate it. If cancer is present, imaging also has a second crucial role: monitoring the patient's response to therapy. Then if the first form of treatment does not work, the clinician can switch to a second that may be more successful — but time is of the essence. Waiting months to discover that a therapy is ineffective may well mean the difference between life and death for the patient.



amuel Achilefu, PhD, professor of radiology and director of the Optical Radiology Laboratory (ORL) at Mallinckrodt Institute of

Radiology, envisions a time when the promising young field of optical imaging will help to save lives by visually penetrating deep into the body to provide both diagnostic information on tumors and the patient's response to therapy. Is cell proliferation or apoptosis (cell death) occurring? What exactly is happening at the molecular level?

"If you think about how soon clinicians need this information, therapeutic response has to be one of the key areas to study," he says. "We think that by using optical methods we will be able to see, within hours of therapy being given, what is happening in the patient's body. That is one of our goals."

With an 18-member research group, Achilefu is focusing on new molecularly targeted probes and strategies to make these highly sensitive evaluations. Most recently, the work in the ORL, which is supported by \$7.5 million in funding from the National Institutes of Health and other sources, has centered on three projects:



Samuel Achilefu, PhD, heads a group of internationally recognized leaders in optical imaging.

- innovative use of fluorescence intensity and lifetime imaging
- development of optical brain function imaging for neonates, in collaboration with Terrie Inder, MD, associate professor of pediatrics; Jeffrey Neil, MD, PhD, professor of neurology; and Amit Mathur, MD, associate professor of pediatrics
- collaboration with interventional radiologists, especially Michael Darcy, MD, professor of radiology and chief of the Institute's interventional radiology section;

Daniel Brown, MD, associate professor of radiology; and James Duncan, MD, PhD, assistant professor of radiology.

 assessment of breast cancer biomakers in collaboration with MIR faculty in the breast imaging section: Barbara Monsees, MD, professor of radiology and chief of breast imaging; Dione Farria, MD, MPH, assistant professor of radiology; and Catherine Appleton, MD, instructor in radiology.

Not that optical imaging and microscopy are altogether a new field: They have been used in such areas as optometry for some time. "But extending optical contrast agents from cell assays into living animals and humans is a new area, and human imaging is still in the early stage of translational research," says Joseph Culver, PhD, an assistant professor of radiology who is developing state-of-the-art tomography systems in the ORL.

## Advances in OPTICAL MAGING

#### UNDERSTANDING OPTICAL IMAGING

In general, imaging takes place along a wide spectrum of light: from short-frequency radiation (conventional X rays and radionuclear imaging, for example), all the way to very long frequency waves (MR). Optical imaging occurs in a narrow window directly in the middle: the visible to infrared spectrum of light, in the 400nanometer to 1600-nanometer range.

This kind of imaging is based on the fact that when light—which consists of electromagnetic waves — shines into an area of the body, two things happen. First, the light is absorbed by the tissue: more heavily by highly light-absorbent proteins, hemoglobin, and cell nuclei; less by lipids and other parts of the tissue. Second, unlike an X ray which can "see" straight through the body, the light used in optical imaging will be scattered as it goes through, creating an "isotropic" effect.

"Because different tissues scatter light differently," says Achilefu, "we can use that information to discriminate between diseased and normal tissue by the pattern of scattering. And because the total volume of blood flowing through cancerous tissue may be increased through angiogenesis, the amount of light absorbed by these tissues will be higher than the amount absorbed by surrounding normal tissue."

The light that researchers shine into the tissue does not emerge all at once, but at minutely different times—measured in nanosecondsdepending on the path the photons take after hitting the target tissue and scattering. Using a detector, Achilefu and his colleagues measure the "temporal spread" or time profile of the photons to determine the precise way in which the light has been absorbed or scattered. Through spectroscopy, they also study color contrasts that tell them whether the light has been absorbed by tissue heavy in oxygen or blood—indicators of cancer.

"Optical methods have a number of contrasts: absorption contrasts and scattering contrasts," says Culver. "The challenge of our lab is to unravel all of the biological sources of contrast so they can be useful in diagnostic imaging."



Barry Edwards, PhD, a research instructor in radiology, is in the Molecular Diapeutics Laboratory where new targeting approaches for cancer detection and treatment are being developed.



#### RECENT ORL RESEARCH PROJECTS

One current aim of the ORL staff is to build a micro-optical system for small animal tomography, similar to a PET scanner. In the area of neuroimaging, ORL researchers are working to develop a tomography system that has a high-density grid of fiber optics and better spatial resolution than found in currently available commercial systems.

"Previous optical brain mapping in humans has not been very precise. Typically, left brain could be distinguished from right brain, front from back, but the maps lacked detail," says Culver. "Another problem has been separating the brain signal from the scalp signal, so we've developed a high-density tomography approach that gives us much more detailed maps of brain function."

To begin with, the researchers have been spatially mapping in the visual cortex, differentiating the central areas of vision from the peripheral through instrumentation that makes some 350 total measurements—far more than the 50 measurements made by existing equipment. They have chosen the visual cortex as a starting point, in part because of its traditional role as a proving ground for new neuroimaging methods but also because it will help in diagnosing children who have problems with their visual circuitry, due perhaps to an early stroke or other birth accident.

Working with pediatric researchers from St. Louis Children's Hospital, the ORL staff are establishing a protocol for a new project that will assess the brain function of pre-term infants, in hopes of giving clinicians an early indicator of problems that could lead to early therapies.



Staff scientist Sharon Bloch, PhD, uses a confocal laser scanning microscope outfitted with a 780-nanometer laser for obtaining high-resolution, blur-free images and three-dimensional reconstructions.

#### FLUORESCENCE LIFETIME IMAGING

At the same time, they have been interested in a new branch of research called fluorescence lifetime imaging. "It is no longer sufficient to say that we can find the problem," says Achilefu. "We want to discover exactly what is happening, so we can use that information to predict the patient's prognosis or treatment response."

To do that, they have begun to measure the time a molecule that is energized by light spends out of its normal resting state and in an activated or "excited" state of fluorescence. This happens in everyday life: Illuminate a white object with ultraviolet or blue light, for example, and the light may come out as green; the color depends upon the molecules that are activated. In general, the amount of time the molecules spend in that excited state of fluorescence before returning to their resting state is called their "lifetime."

To gather information on suspicious tissue, scientists insert molecular probes into the patient's body; the probes are delivered to the tumor site. In combination with optical imaging, the scientists use those agents to report on the nature of the molecules inside the tissue itself.

"Fluorescence lifetime imaging is useful to us because of the multiplex information it provides," says Achilefu. "If those molecules are in an acidic environment, they will have a different lifetime; if they are binding to something, they will have another lifetime. So if scientists know the behavior of the molecular probe in a given environment, they can predict what is happening: the functional state of that tissue and, therefore, which tissue is tied to cancer."

Altogether, Achilefu and the ORL staff hope this cutting-edge work in optical imaging will eventually have a major clinical impact, making it possible to characterize tissue more accurately and more quickly than ever before.



The 92nd Scientific Assembly and Annual Meeting of the Radiological Society of North America

> November 26 – December 1, 2006 McCormick Place Chicago, Illinois

"This year's theme, 'Strengthening Professionalism,' serves as a compelling reminder of our obligations to improve the standard of care in today's complex medical environment. ... By honoring our commitment to professionalism, we dedicate ourselves to improving care for our patients." —excerpted from the welcoming message given by Robert Hattery, MD, 2006 RSNA president



# JOST IS 2007 RSNA PRESIDENT

Gilbert Jost, MD, was inaugurated on November 30 as president of the Radiological Society of North America (RSNA)—an organization of more than 39,000 radiologists, radiation oncologists, medical physicists and related scientists. Jost was elected to the RSNA Board of Directors in 1999 as the liaison-delegate for Communications and He was one of the first members of the RSNA Integrating the Healthcare Enterprise (IHE) Planning Committee and the IHE Strategic Committee and was an early promoter of the IHE movement, a system for allowing different manufacturers' medical computer systems to communicate with one another. Jost was quoted in RSNA's *Daily Bulletin*, a newsletter

Corporate Relations; he was the 2006 chair of the RSNA Board of Directors. He has been involved in many RSNA endeavors, including the Strategic Planning Committee, the Education Council, the Publications Council, and the Medical Imaging Resource Center (MIRC) Committee.

Jost is recognized worldwide for using information technology to improve diagnostic radiology.



distributed during the 92nd Annual Meeting: "These are exciting times, and times of great change for our specialty. The challenge for RSNA is to stay abreast of the changes and help keep radiologists at the forefront of the rapid developments in the field of medical imaging. I have no doubt that RSNA will continue to meet this challenge with areat effectiveness."

#### **MIR PRESENTATIONS AT RSNA 2006**

EXHIBITS AND DEMONSTRATIONS Nirvikar Dahiya, MD; Sharlene Teefey, MD; William Middleton, MD; Martin Boyer, MD, "Sonography of the hand and wrist: a comprehensive review"— CERTIFICATE OF MERIT AWARD

Meghan Lubner, MD; Christine Menias, MD; Christine Peterson, MD; Lisa Wang, MD; Sanjeev Bhalla, MD; Jay Heiken, MD, "CT features of cecal volvulus"—CERTIFICATE OF MERIT AWARD

Nirvikar Dahiya, MD; Sharlene Teefey, MD; William Middleton, MD, "Three-dimensional ultrasound: tutorial on basic techniques and applications" —CERTIFICATE OF MERIT AWARD

#### Nirvikar Dahiya, MD; Sharlene Teefey, MD; William Middleton, MD; Cary Siegel, MD; Neha Dahiya, MD; Boopathy Vijayaraghavan, MD,

"Sonography of genitourinary tuberculosis with an emphasis on high-resolution and 3D imaging" —EXCELLENCE IN DESIGN AWARD Christine Peterson, MD; Christine Menias, MD; Gilbert Cheung, MD; Amy Hara, MD; Perry Pickhardt, MD; Dennis Balfe, MD, "Gastrointestinal lymphoma: beyond the excenteric mass" —CERTIFICATE OF MERIT AWARD

Christine Peterson, MD; Edward Hwang, MD; Christine Menias, MD; Lisa Wang, MD; Cary Siegel, MD; Khaled Elsayes, MD, "Imaging of male urethral stricture disease with surgical correlation"—CERTIFICATE OF MERIT AWARD

John Anderson, MD; Christine Peterson, MD: Christine Menias, MD; Dennis Balfe, MD; Jeffrey Carenza, MD; Amy Hara, MD, "Twister: a multimodality pictorial review of gastrointestinal volvulus"

Catherine Appleton, MD; Christine Peterson, MD; Christine Menias, MD; Amy Nordmann, MD; Mary Ellen Swatske, RN, "A pictorial display of breast findings on computed tomography: correlation with breast imaging" Sanjeev Bhalla, MD; Andrew Bierhals, MD, MPH; Perry Pickhardt, MD; Christine Menias, MD; Cylen Javidan-Nejad, MD; Fernando Gutierrez, MD, "Pass or mass? A location-based approach to cardiac masses and pseudomasses"

Sanjeev Bhalla, MD; Kristopher Cummings, MD; Christine Menias, MD; Cylen Javidan-Nejad, MD; Pamela Woodard, MD; Fernando Gutierrez, MD, "The ABCs of VSDs: understanding ventricular septal defects"

David Gierada, MD; Jason Woods, PhD; Cliff Choong, MD; Andrew Bierhals, MD, MPH; Seth Bartel; Jon Ritter; Thomas Pilgram, PhD; Y. Chang; R. Jacob; Dmitriy Yablonskiy, PhD; Cheng Hong, MD, PhD; Nitin Das; J Hogg; Joel Cooper, MD; Alexander Patterson, MD; Bryan Meyers, MD; Richard Battafarano, MD; Mark Conradi, PhD, "Optimization of low dose CT and 3He diffusion MR techniques for quantifying emphysema"

## Angelle Harper, MD; Christine

Angelle Harper, MD; Christine Menias, MD; Vamsidhar Narra, MD; Wincha Chong, MD; Christine Peterson, MD; Jeffrey Brown, MD, "Diffuse liver disease"

David Kim, MD; Perry Pickhardt, MD; Andrew Taylor, MD; Christine Menias, MD, "Imaging evaluation of suspected complications resulting from optical colonoscopy"

Miyoung Kim, MD, PhD; Kyung Won Lee; Sanjeev Bhalla, MD; Kyongtae Bae, MD, PhD, "Foreign bodies and liquid aspiration pneumonia: MDCT findings"



Meghan Lubner, MD; Christine Menias, MD; Christine Peterson, MD; Lisa Wang, MD; Amy Hara, MD; Sanjeev Bhalla, MD; Dennis Balfe, MD, "CT imaging features of cecal volvulus"

Christine Menias, MD; Wendy Horn, MD; Genevieve Bennett, MD; Christine Peterson, MD; Sanjeev Bhalla, MD; Khaled Elsayes, MD, "CT features of adnexal torsion: pictorial review"

Christine Menias, MD; Srinivasa Prasad, MD; Venkateswar Rao Surabhi, MD; Vamsidhar Narra, MD; Dushyant Sahani, MD; Sanjeev Bhalla, MD, "Mimics of cholangiocarcinoma"

Jeff Miller, MD; Alpay Ozcan, DSc; Asif Moinuddin, MD; Robert Almli, MD; Robert McKinstry, MD, PhD, "Pediatric automated diffusion tensor MRI white matter tissue segmentation: qualitative and quantitative developmental changes" Srinivasa Prasad, MD; Christine Menias, MD; Venkateswar Rao Surabhi, MD; Vamsidhar Narra, MD; Khaled Elsayes, MD; Peter Humphrey, MD, "Neoplastic and non-neoplastic disorders of the perirenal space revisited: imaging findings with pathological correlation"

Srinivasa Prasad, MD; Venkateswar Rao Surabhi, MD; Christine Menias, MD; Phyllis Huettner, MD; Vamsidhar Narra, MD; Kedar Chintapalli, MD, "Recent advances in endometriosis: associated ovarian carcinomas—implications on imaging and management"

Fred Prior, PhD; John Kotyk, PhD; Lawrence Tarbox, PhD; Stephen Moore, MS; Mark Mintun, MD, "The development of an information and workflow management system for a Center for Clinical Imaging Research"

Fred Prior, PhD; Lawrence Tarbox, PhD; Stephen Powell; Stephen Moore, MS; David Perry, "RMS: a workflow and information management solution for translational research"

Fred Prior, PhD, "XIP: eXtensible imaging platform (an open source workstation)"

Sherif Radwan, MD; Khaled Elsayes, MD; Hatem Abou El Abbass, MD; Ibrahim El Nogoomi, MD; Yahia Mostafa, MD; Christine Menias, MD, "Adhesive intestinal obstruction (AIO): How can imaging findings implicate treatment strategy?"

Gujjarrapa Srinivas, MD; Carlos Restrepo, MD; Christine Menias, MD; Kedar Chintapalli, MD, "Cross sectional imaging spectrum of acute esophageal disorders"

Quan Vu, MD; Lisa Wang, MD; Christine Menias, MD; Christine Peterson, MD; Brett Gratz, MD; Dennis Balfe, MD, "Imaging features of aorto-enteric fistula"

Xia Wang, MD; Tom Miller, MD, PhD; Kyongtae Bae, MD, PhD, "Evaluation of pleural uptake with FDG-PET/CT"

#### INFORMATICS

Jerold Wallis, MD, instructor: IHE nuclear medicine: what's new in 2006?

#### **REFRESHER COURSES**

**Dennis Balfe, MD,** instructor: Imaging of the gallbladder and biliary tree: diagnosing malignant lesions



**Sanjeev Bhalla, MD**, instructor: Current CT techniques for imaging medical emergencies: thoracic emergencies

**Michael Darcy, MD,** instructor: Case-based review of interventional radiology: nonvascular interventions

Jay Heiken, MD, instructor: CT of the acute abdomen: bowel origin (an interactive session)

**David Hovsepian, MD,** instructor: Hysterosalpingography and selective salpingography ("hands-on workshop")

**Eric Klein, MS,** instructor: Transition to heterogeneity corrections

**Christine Menias, MD**, instructor: Current CT techniques for imaging medical emergencies: abdominal and pelvic emergencies

**Barbara Monsees, MD,** instructor: Update course in diagnostic radiology: breast imaging—mammography: interpretation pointers for detection of early breast cancer: supplementary views

Jeff Michalski, MD, instructor: Imaging and prostate cancer radiation treatment planning: therapy; Case-based review of radiation oncology: thoracic cancers; Case-based review of radiation oncology: breast cancers; Case-based review of radiation oncology: gynecologic cancers; Case-based review of radiation oncology: gastrointestinal cancers

Sasa Mutic, MS, instructor: Minicourse: image optimization for radiation therapy treatment planning—CT, MR, and PET review: PET review; Image optimization for radiation therapy treatment planning: CT, MR, and PET review

Vamsidhar Narra, MD, instructor: Imaging and prostate cancer radiation treatment planning: imaging

David Piwnica-Worms, MD, PhD, instructor: Molecular-genetic imaging—

reporter systems in molecular imaging: a comparative analysis

**Marilyn Siegel, MD,** instructor: Multidetector CT of pediatric cardiovascular disorders; Pediatric vascular imaging with CT and MR; Pediatric vascular imaging with CT and MR: thoracoabdominal

Wade Thorstad, MD, instructor: Radioimmunotherapy



SCIENTIFIC PRESENTATIONS Dennis Balfe, MD, presiding officer: Gastrointestinal (gastrointestinal oncology CT/PET)

Michael Darcy, MD, presiding officer: Vascular/interventional (vascular)

**Louis Gilula, MD,** presiding officer: ISP: musculoskeletal (vertebroplasty & kyphoplasty)

Jay Heiken, MD, presiding officer: Gastrointestinal (liver CT and MR: diffuse disease, fibrosis, and steatosis)

**Barbara Monsees, MD,** presiding officer: Breast imaging (multiple modalities)

Suresh Vedantham, MD, moderator: ISP: vascular interventional panel discussion

Pamela Woodard, MD, presiding officer: Cardiac (CT)

Nirvikar Dahiya, MD; Sharlene Teefey, MD; William Middleton, MD; Martin Boyer, MD, "Sonography of simple, complex, and collapsed ganglions of the hand and wrist: a morphologic analysis"

Steven Don, MD; Bruce Whiting, PhD; Charles Hildebolt, DDS, PhD; Jackie Ellinwood, MS; Jim Sehnert, PhD; Parinaz Massoumzadeh, PhD; Richard Kraus, MD; Keith Kronemer, MD; Rebecca Hulett, MD; Tatum Johnson, MD, "Observer performance in the detection of neonatal pneumothorax: use of a stochastic noise generator to simulate reduced dose computed radiography" Steven Don, MD; Bruce Whiting, PhD; Parinaz Massoumzadeh, PhD, "CT stochastic noise generation: the effect of noise on the detection of sub-5-mm lesions and implication for dose reduction"

Alexander Ho, MD; Michael Darcy, MD; Jennifer Gould, MD: Joel Picus, MD; Benjamin Tan, MD; Daniel Brown, MD, "Long-term chemoembolization outcomes for patients with hepatic metastases from neuroendocrine tumors"

Cheng Hong, MD, PhD; Kyongtae Bae, MD, PhD; Brian Seeck; Pamela Woodard, MD, "Contrast enhancement in 64-slice cardiac MDCT: effect of body weight and body mass index"

Glenn Kaplan, MD; Vamsidhar Narra, MD; William Chapman, MD; Jeffrey Brown, MD; Christine Menias, MD; Kyongtae Bae, MD, PhD, "Contrastenhanced MRI combined with MRCP is highly accurate for preoperative assessment of surgical resectability in patients with cholangiocarcinoma"

Sooah Kim, MD; Lisa Wang, MD; Jay Heiken, MD; Cary Siegel, MD; Charles Hildebolt, DDS, PhD; Kyongtae Bae, MD, PhD, "Genitourinary (lower tract). Improvement in opacification of the urinary bladder and ureter in MDCT urography: effect of a log-roll procedure and post-void bladder residual"

Parinaz Massoumzadeh, PhD; Cylen Javidan-Nejad, MD; Sooah Kim, MD; Miyoung Kim, MD, PhD; Kyung Won Lee, MD; Yuting Liang, MD, PhD; Bruce Whiting, PhD; Kyongtae Bae, MD, PhD, "Radiation dose reduction in CT pulmonary embolism CT: assessment with low-radiation dose CT images simulated from clinical scans"



Fang Zhu, MD, PhD; Cheng Tao, MD; Paul Commean; Thomas Pilgram, PhD; David Gierada, MD; Kyongtae Bae, MD, PhD, "Variability in 3-D volumetric measurement of pulmonary nodules in screening chest MDCT"

TOWN HALL MEETING Barry Siegel, MD, moderator: National Oncologic PET Registry (NOPR)



FOCAL SPOT, WINTER 2006/2007





Above: (Left to right) Lawrence Tarbox, PhD, and Bruce Whiting, PhD, and Fred Prior, PhD, of MIR's Electronic Radiology Laboratory (ERL); Michael Heath, PhD, and Lynn Heath, PhD, of Eastman Kodak Company; Parinaz Massoumzadeh, PhD, of the ERL.

1

Right: Joseph Erinjeri, MD, diagnostic radiology chief resident 2006-2007, and Tess Williams Chapman, MD.



Above: (Left to right) Dana Davis; Tim Davis, MD;

Right: Alumni Robert Stanley, MD, chair of the Department of Radiology, University of Alabama, Birmingham, and (right) Ronald Evens, MD, former MIR director.



MALLINCKRODT INSTITUTE OF RADIOLOGY



Above: David Rubin, MD, chief of MIR's musculoskeletal radiology, and (right) alumnus James Brink, MD, chair of the Department of Radiology, Yale University.

Right: Doctor Charles and Genemé Keyser.

Far Right: A closer look at the 38-foot Tiffany dome and the ornately decorated walls in the Preston Bradley Hall.

×

Left: Shao-Pow Lin, MD, fourth-year diagnostic radiology resident, and (right) Asif Moinuddin, MD, second-year nuclear medicine resident.

Below: Gilbert Jost, MD, chair of the Department of Radiology and director of the Institute; (background) Bruce Whiting, PhD; and Matt Powers, MD.







Above, left: Alumnus Hal Bennett, MD, and (right) Jeffrey Brown, MD, co-chief of MIR's body magnetic resonance imaging.

Above, right: Daniel Kido, MD, former chief of MIR's neuroradiology section, and Robin Yang, MD, third-year diagnostic radiology resident.

Left: Alumni Kyongtae Bae, MD, PhD, and (right) Richard Slone, MD.

# Taking Mammography Screening on the Road A third-generation mobile mammography unit moves diagnosis forward



hen the Mallinckrodt Institute of Radiology (MIR) Mammography Mobile-the linchpin of the Institute's mammography outreach program—was launched in August of 1986, it was one of only five such units in the United States and the first in the Midwest.

by Vicki Kunkler

Corporate partnerships, established first with Boatmen's National Bank of St. Louis and, later, with Schnuck Markets, were designed to take affordable, convenient, high-quality breast-cancer screening to women in their workplace and in their neighborhood. The blue-and-silver van became a familiar sight around the metro-St. Louis area. By the van's fifth anniversary, the program's success was evident:

- Approximately 14,000 screenings had been performed at Schnuck Markets locations.
- More than 2,850 mammograms were provided to Boatmen's employees.
- Participation in the outreach program included 70 area corporations.
- On average, about 40 women per day, five days a week, underwent screening mammography on the van.

#### Expanding the Outreach Program

In April 1992, with the creation of Barnes-Jewish Hospital's (BJH's) Department of Radiology, the technical portion of Mallinckrodt Institute was transferred to the hospital; the professional component remained with the Institute and Washington University School of Medicine. And with that transfer went the mammography van and the outreach program.

In late 1992, a newer version of the mammography van made its debut, with an interpretation of Claude Monet's "The Poppy Field" blanketing the exterior. Sponsored by BJH in conjunction with MIR, the van expanded its travels and began covering areas throughout the state of Missouri, including the • working with the Siteman Cancer Center (SCC) Refugee and New American Program to provide breast-cancer screening for women from diverse cultures

 creation of a mammography registry of those patients utilizing the Mobile Mammography Outreach Program, thus facilitating program planning and providing a tool for better understanding the mammography needs of underserved women in the St. Louis communities.

#### Going digital

Physicians from 33 sites in North America, including investigators at Mallinckrodt Institute, interpreted both film and digital screening mammograms as part of the Digital Mammographic Imaging

Screening Trial (DMIST). In 2005, published results showed that mammograms obtained digitally or by conventional film were equally effective. However, digital mammography's ace-in-the hole is in detecting breast cancer in women who are premenopausal or perimenopausal, are Barbara Monsees, MD, chief of MIR's breast imaging, and (right) Susan Kraenzle, RN, manager of the SCC Breast Health Center, at the ribbon-cutting ceremony for the 2006 mammography van.



at the Alvin J. Siteman Cancer Center (SCC), is committed to improving the health and well-being of women in the greater St. Louis area and beyond.

In October 2006, the SCC put a new mobile unit—equipped with digital technology and certified by the United States Food and Drug Administration—on the road. The eye-catching van incorporates an artistic illustration celebrating "every woman everywhere," a reference to the Outreach Program's creed that lifesaving breast-cancer screening and education should be available to every woman in the St. Louis area and beyond.

> Editor's Note: Call 314-747-7222 (or toll-free at 800-600-3606) to make an appointment for the mammography van.



rural communities in the Bootheel region of Missouri. The Mobile Mammography Outreach Program, as it is officially called, experienced tremendous growth during the next several years:

- providing new programs at neighborhood clinics and health centers
- participation in neighborhood events and health fairs
- collaboration with the Jefferson County and St. Francois County Health departments
- partnership with Southeast Missouri Health Network to provide free breast-cancer and cervicalcancer screenings to eligible, lowincome, underinsured or uninsured Missouri women aged 35 to 64

younger than 50, or have dense breast tissue—in other words, at least 50 percent of women in the United States. Plus, the digital images stored in computers allow radiologists to use software that optimizes evaluation of breast tissue.

The Mobile Mammography Outreach Program, now coordinated by the Breast Health Center



# by Mark

t

r



Diagnostic ultrasonography has long been a valuable tool

for assessing lesions and disease patterns involving small body parts (such as the thyroid, muscles, and tendons) and internal organs (such as the liver and kidneys). It is a multiplanar imaging tool—useful only while the patient is in the procedure room. After the patient leaves the room, sonographers and radiologists have only twodimensional (2-D) images to work with. What they see is what they get. Now, enter real-time, three-dimensional (3-D) ultrasound, commonly called four-dimensional (4-D) ultrasound—the fourth dimension is time. Imagine acquiring the relevant data, bidding the patient good-by, and then sitting at a computer console to study the acquired information from perspectives only previously dreamed about. Imagine recreating 2-D images in any plane.



Sagittal and coronal reformation of endometrial polyp (arrows). Coronal plane for visualizing uterine cavity is reconstructed using 3-D volume on right side. This coronal plane cannot be obtained with 2D.

"Three-dimensional or volume ultrasound acquires data from the region of interest in a block of information and allows radiologists to look at the region from all sides-different aspects and margins-as a 3-D solid block. Volume of a specific lesion in that block can be calculated, and the lesion can be evaluated for its shape variations and spatial relationship to other structures," says Nirvikar Dahiya, MD, a clinical fellow in abdominal imaging who is specializing in ultrasonography at Mallinckrodt Institute of Radiology (MIR). He has worked with the technology in India for a number of years and is the coauthor of one of the first books on the subject-3D & 4D Ultrasound: A Text and Atlas. He is considered MIR's expert on 3-D/4-D ultrasound and is helping to educate MIR staff about the newly acquired 3-D equipment. Dahiya says that, besides the volume of data produced, 3-D/4-D ultrasound has other advantages.

#### **3-D/4-D** TECHNOLOGY

#### Pros

- Can replace computed tomography in some applications, avoiding radiation exposure
- Allows shorter exam times
- Allows manipulation of data to obtain more information for treatment planning, chemotherapy, radiotherapy, and surgery
- Allows tracking of volume change with treatment, even for multiple lesions



"By being able to manipulate the data (such as multisectional imaging and rendering) in new ways long after the patient leaves the procedure room, 3-D ultrasound brings the technology closer to that of CT [computed tomography] and

Doctors Teefey and Dahiya are shown with an ultrasound machine equipped with 3-D/4-D technology. MRI [magnetic resonance imaging]—technology that always has allowed radiologists to tweak data at the workstations. The new ultrasound system allows us to recreate the coronal, or frontal, plane in relation to lesions in the breast or uterus. We couldn't do that with 2-D ultrasound."

Another advantage, he says, is being able to calculate the volume of a lesion or organ more precisely. In 2-D ultrasound, a mathematical formula is used to determine the volume, and that formula assumes the lesion is a uniform shape. In reality, the shape may be irregular or have "fingers" that extend to the periphery. The new ultrasound can capture all of the different shapes and margins in various planes to obtain a more accurate volume calculation, for example, of a tumor in the liver. It makes planning for radiotherapy and follow-up more accurate. "Some organs can be visualized better by CT than by ultrasound; but ultrasound remains a valuable diagnostic tool in many

areas, and

version versio

3-]

ro

nc

"Т

in

ex

se

ak

tra

w

ak

tc

Ca

S

te

Ca

th

3-D ultrasound only enhances its role. Unlike CT, ultrasound uses no ionizing radiation," says Dahiya. "The 3-D/4-D technology has been in use for three to four years, extensively in obstetrics for fetal scanning and for identifying fetal abnormalities. We also use it for transvaginal ultrasounds because we can look for congenital uterine abnormalities more efficiently."

7.

He adds this caution: "We have to remember that anything that cannot be visualized on 2-D ultrasound will not be visualized by 3-D technology. And 3-D ultrasound cannot circumvent the artifacts that appear on 2-D imaging."

Although medical equipment vendors have long offered 3-D systems, radiologists were not that interested in the past because of the longer time required for diagnostic exams—plus the software was just too cumbersome. Newer equipment obtains volumes of data from an examination that can be acquired quickly and studied later. In the past, ultrasound scanners and workstations created volumetric reconstruction that once processed could not be changed. With the new equipment, radiologists now can go back to the original volume and view them in different planes to obtain more information. Even when images are not acquired in the coronal plane, the new software can create it.

Dahiya says the information added by multiple or unique planes may be critical: "The multiple rendering techniques that can be applied to the volume data—on a hollow viscous organ or a solid parenchymal structure—sometimes contribute a minuscule bit of extra information, but that can make all the difference in making a diagnosis."



Top: 2-D (left) and 3-D rendered image (right) of small uretero-vesicle calculus (arrows). Surface-rendering technique on right creates virtual cystoscopic image of base of urinary bladder with UV calculus seen elevating mucosa at ureteric orifice.

Bottom: Color Doppler image of a uterine arterio-venous fistula. 3-D image (right) shows a glass-body-rendering technique that subdues gray voxels in the volume, allowing visualization of entire vascular malformation.

There is a significant learning curve with the new technology. Staff must develop expertise both with performing the examination and using the software. "Only recently has the technology been available in Mallinckrodt Institute's abdominal imaging," says Dahiya. "Although it is still in an exploratory phase for abdominal imaging applications, 3-D/4-D ultrasound has made waves in obstetrics and gynecology. At the Institute, we plan to be front-runners in experimenting with this technology in areas related to thyroid and



#### CONVENTIONAL **ULTRASONOGRAPHY** AT MIR

For the past three decades, ultrasonography has provided radiologists at Mallinckrodt Institute with a noninvasive and relatively inexpensive means of imaging the human body's structures. No radiation is used in ultrasound equipment. There are no known harmful effects on humans.

By applying the Doppler principle (developed in 1842 by Johann Doppler) sound waves are transmitted into the body by a small probe called a transducer that is placed the internal organs are analyzed to create a two-dimensional image of the soft tissues and a readout of the blood flow in the vessels.

In 1987, the Institute's ultrasound specialists began to use color Doppler sonography, a major advancement that displays soft tissue in gray-scale and vessels in color. Doppler ultrasound is an invaluable method of noninvasively investigating vessels. All of the ultrasound-equipped rooms at Mallinckrodt Institute have modern, color Doppler units.

Coronal

aaitta

In ti facu Dep

#### N Val

inst sion Mai inst

PI

sion

San asso ogy sor Rad

Car asso radi pro sior

Dio assi rad asse ogy Rac

> Day ass rad top Div Rac

She ass rad

ass ogy Sci

The three orthogonal planes (sagittal, coronal and axial) of the gallbladder reconstructed in a multiplanar mode from the acquired volume. Bottom right image shows surface rendering of gallbladder lumen. A polyp is protruding from the wall (arrow).

scrotal imaging, the musculoskeletal system, liver, gallbladder, kidneys, urinary bladder, and female genital tract."

Sharlene Teefey, MD, director of diagnostic ultrasound, shares Dahiya's enthusiasm for the new technology. "We have had the current equipment for only a few months and are now exploring research applications. The 3-D/4-D ultrasound technology has great and exciting potential for answering many different clinical questions as well as improving patient throughput. Although it is actively used in many OB [obstetrical] practices, clinical use in non-OB applications is in its infancy but is being explored."

Teefey explains what makes the new equipment more exciting: "We have a vision that, as with CT, a sonographer will be able to efficiently acquire images that later will be reformatted (by a sonologist at a remote, central 3-D/4-D workstation) to provide detailed images

different planes. We will be able to evaluate many organs in three dimensions (such as the bladder and the gallbladder) as well as solid viscera (such as the liver, kidney, spleen, and uterus) for tumors and stones. It also will be possible to determine tumor volume, assist with presurgical planning by demonstrating the relationship of a tumor to nearby vascular structures, and to monitor volumetric changes in response to chemotherapy.'

and measurements in multiple,

"We're very excited to have this equipment," adds Teefey. "Ultrasound technology has been on a plateau for a number of years but is now moving forward. We are excited about exploring some of the clinical applications of 3-D/4-D ultrasound." MIR

MALLINCKRODT INSTITUTE OF RADIOLOGY



In this section, the names of employees who are full-time faculty or staff or who have an appointment in the Department of Radiology are highlighted in boldface type.

#### NEW FACULTY

Valerie Reichert, MD, instructor in radiology, Division of Diagnostic Radiology.

Mai Xu, MD, PhD, research instructor in radiology, Division of Radiological Sciences.

#### PROMOTIONS

Samuel Achilefu, PhD, associate professor of radiology, was promoted to professor of radiology, Division of Radiological Sciences.

**Carolyn Anderson, PhD**, associate professor of radiology, was promoted to professor of radiology, Division of Radiological Sciences.

**Dione Farria, MD, MPH**, assistant professor of radiology, was promoted to associate professor of radiology, Division of Diagnostic Radiology.

**David Hovsepian, MD**, associate professor of radiology, was promoted to professor of radiology, Division of Diagnostic Radiology.

**Sheng-Kwei Song, PhD**, assistant professor of radiology, was promoted to associate professor of radiology, Division of Radiological Sciences.

#### Zhude Tu, MD, PhD,

research instructor in radiology, was promoted to

research assistant professor of radiology, Division of Radiological Sciences.

#### JOINT APPOINTMENTS

Joseph Klaesner, PhD, research assistant professor of physical therapy, was appointed research assistant professor of radiology, Division of Radiological Sciences.

**Robert McKinstry, MD, PhD**, associate professor of radiology, was appointed associate professor of pediatrics, Department of Pediatrics.

**Michael Mueller, PT, PhD**, associate professor of physical therapy, was appointed research associate professor of radiology, Division of Radiological Sciences.

Karen Wooley, PhD,

professor of chemistry, was appointed professor of radiology, Division of Radiological Sciences.

**Dequan Zou, DSc**, research assistant professor of physical therapy, was appointed research assistant professor of radiology, Division of Radiological Sciences.

#### GRANTS

Samuel Achilefu, PhD, associate professor of radiol-

ogy, as principal investigator of a four-year grant from the National Institutes of Health, received \$2.1 million for research on "Multiphoton microscopy using near infrared dyes." Coinvestigator is Siavash Yazdanfar, GE Global Research.

Colin Derdeyn, MD, associate professor of radiology and of neurology and neurological surgery, as principal investigator, received a \$1.1 million grant from the National Institute of Neurological Disorders and Stroke for research on "The role of cerebral hemodynamics in moyamoya disease." Coinvestigators for the five-year grant are William Powers, MD, professor of neurology and neurological surgery and of radiology; Robert Grubb, MD, professor of neurological surgery and of radiology; Michael Chicoine, MD, Department of Neurosurgery; and Tom Videen, PhD, research associate professor of neurology and neurological surgery and of radiology.

#### Lawrence Tarbox, PhD,

research assistant professor of radiology, as principal investigator, received a \$467,262 contract from the In Vivo Imaging Workspace of the Cancer Biomedical Informatics Grid (caBIG) project sponsored by the National Cancer Institute. The contract was awarded to a combined Washington University/

Siemens Corporate Research team for the "eXtensible Imaging Platform Development Project." Washington University team members are Stephen Moore, MS, research associate professor of radiology: Rakesh Nagarajan, MD, PhD, Department of Pathology; Fred Prior, PhD, research associate professor of radiology; and Electronic Radiology Laboratory staff. Gianluca Paladini; Klaus Engel, PhD; Thomas Moeller, MS; Daphne Yu, MSE; and John Pearson, PhD, are from Siemens Corporate Research.

#### APPOINTMENTS/ ELECTIONS

Jay Heiken, MD, professor of radiology, was appointed to a four-year term on the Board of Trustees of the International Cancer Imaging Society and to a six-year term on the Board of Directors of the Society of Gastrointestinal Radiologists.

**Joel Perlmutter, MD**, professor of neurology, of radiology, and of physical therapy, was appointed to the Editorial Board of the journal *Neurology*.

# YI

#### APPOINTMENTS/ ELECTIONS

Continued from page 31

#### Jeffrey Zacks, PhD,

assistant professor of psychology and of radiology, was appointed to the editorial boards of *Projections: The Journal for Movies and Mind* and the *Journal of Experimental Psychology: General.* 

#### Honors/ Awards

Kevin Black, MD, associate professor of psychiatry, of neurology, of radiology, and of anatomy and neurobiology, received the Hope Award from the St. Louis chapter of the Huntington Disease Society of America.

#### Joel Perlmutter, MD,

professor of neurology, of radiology, and of physical therapy, received the Washington University School of Medicine Distinguished Service Teaching Award for Class of 2008.

#### James Quirk, PhD, research instructor in radiology, was named chair-elect of the MR in Drug Research Study Group of the International Society for Magnetic

Resonance in Medicine.

**Yuan-Chuan Tai, PhD**, assistant professor of radiology, was named chair of the Small Animal Imaging Session for the 2006 Institute of Electrical & Electronic Engineers Nuclear Science Symposium and Medical Imaging Conference.

**Lawrence Tarbox, PhD**, research assistant professor of radiology, was selected as chair of the 2008 Third International DICOM Conference and Workshop.

#### LECTURES

Samuel Achilefu, PhD, associate professor of radiology, as a Walther Cancer Institute lecturer, presented "Evolution of diagnostic imaging" at the University of Notre Dame, Indiana, October 9. He spoke on "Nanomolecules and nanoparticles in optical tumor imaging" at the National Institutes of Health Workshop on Translation Research: Optical Imaging, Bethesda, Maryland, October 30. He spoke on "Discovery and development of diagnostic and therapeutic drugs for medical intervention" at the Molecular Basis of Diseases **MBD** Distinguished Lecture Series, Georgia State University, Atlanta, November 2. Achilefu presented "Applications of imaging technologies in diagnostic medicine" at the NSF/NIST/NIBIB Workshop on Enhancing Innovation/Competitiveness, Arlington, Virginia, December 3. He spoke on "Spying cancers with colorful molecules" at the Modern Optics and Spectroscopy Seminar, sponsored by Massachusetts Institute of Technology, Boston, December 12.

**Kevin Black, MD**, associate professor of psychiatry, of neurology, of radiology, and of anatomy and neurobiology, presented "Diagnosing and treating Tourette syndrome," as part of the Centers for Disease Control and Prevention/Tourette Syndrome Association medical education lecture series, at the Wayne State University/ Children's Hospital of Michigan Department of Neurology Grand Rounds, Detroit, December 7.

Jeffrey Brown, MD, professor of radiology, spoke on "Effective investment strategies for physicians, Part 1: Innovations in finance" and "Effective investment strategies for physicians, Part 2: Innovations in finance" at the American College of Radiology Course on Professional and Financial Success from Training to Retirement, Phoenix, Arizona, November 11 and 12. He spoke on "A physician's guide to financial success" at Radiology Grand Rounds, University of California, San Diego, January 8. Brown presented "Body MR: Should it replace CT?" to the San Diego Radiological Society, January 9. As visiting professor, he spoke on "MR imaging of cholangiocarcinoma" at the University of California, San Diego, January 10.

**Carmen Dence, MS**, research associate professor of radiology, presented "Nuclear medicine, positron emission tomography and production of radiopharmaceuticals" at the Metropolitan Education and Training Center, St. Louis, Missouri, September 28. She spoke on "Use of [C-11] and [F-18] PET radiopharmaceuticals in nuclear medicine molecular imaging" and "Animal handling techniques for multi-modality imaging" at Kyungbuk University Hospital, Seoul, Republic of Korea, October 31. Hep

onco

patie

cer"

treat

Clin

and

of C

Johr

Balt

Octo

Jay

of ra

"Scr

at th

Ima

Mee

Cou

Oct

**Colin Derdeyn, MD**, associate professor of radiology and of neurology and neurological surgery, as the Elizabeth Crosby Visiting Professor, spoke on "Hemodynamics in human cerebrovascular disease" at the University of Michigan Medical School, Department of Neurological Surgery, Ann Arbor, October 27.

Joel Garbow, PhD, research associate professor of radiology, presented "MRI studies of neurofibromatosis—1 mouse optic glioma" at The Clore Workshop on Novel Imaging Techniques in Disease Models, Weizmann Institute of Science, Rehovot, Israel, October 22.

Louis Gilula, MD, professor of radiology and of surgery, as visiting professor, presented "Introduction to vertebroplasty" and "Plain film approach to bone neoplasms" at the Oregon Health and Science University (OHSU), Portland, October 5 and 6. He also presented "Complex carpal trauma" at OHSU, December 18.

**Perry Grigsby, MD**, professor of radiation oncology and of radiology, spoke on "FDG-PET in cervical cancer" and "Imaging for cervical cancer" at the 11<sup>th</sup> Biennial International Gynecologic Cancer Society Meeting, Santa Monica, California, October 14-18.

# FY

He presented "A radiation oncologist's use of PET in patients with cervical cancer" and "Planning radiation treatment with PET/CT" at Clinical PET/CT: To Plan and Monitor the Treatment of Cancer, sponsored by Johns Hopkins University, Baltimore, Maryland, October 27 and 28.

Jay Heiken, MD, professor of radiology, spoke on "Screening for colon cancer" at the International Cancer Imaging Society's 6<sup>th</sup> Annual Meeting and Teaching Course, Dublin, Ireland, October 16-18. Jason Lewis, PhD, assistant professor of radiology, presented "PET imaging of tumor hypoxia with Cu-ATSM" at the Azienda Ospedaliero-Universitaria Careggi, Florence, Italy, November 15. He spoke on "Application of Cu-64 radiopharmaceuticals for imaging and therapy" at the Ospedale Maggiore, Milan, Italy, November 16.

**Robert McKinstry, MD, PhD**, associate professor of radiology and of pediatrics, spoke on "Radiology medication reconciliation procedure" at The Society for Chiefs of Radiology at Children's

Hospitals meeting, Chicago,

Illinois, October 13. He presented "Neuroimaging update" at the SIT Trial 2006 Investigators Meeting, Baltimore, Maryland, November 13. He spoke on "MR techniques in neonates and infants with epilepsy" at the Detailed Imaging and Surgical Assessment Symposium at the American Epilepsy Society Annual Meeting, San Diego, California, December 2.

Mark Mintun, MD, professor of radiology and of psychiatry, as the 2006 Turken lecturer, presented "Amyloid plaque imaging with PIB: Where do we go now?" at Neurology Grand Rounds, Alzheimer Disease Research Center at David Geffen School of Medicine, University of California, Los Angeles, November 8.

#### Joel Perlmutter, MD,

professor of neurology, of radiology, and of physical therapy, presented "Neuroimaging biomarkers for movement disorders research" and "Evidence for bilateral pathways mediating rigidity in Parkinson disease' at the 10<sup>th</sup> International Congress of Parkinson's Disease and Movement Disorders, Kyoto, Japan, October 28-November 2. He spoke on "PET studies of dystonia" at the Bachmann-Strauss Dystonia & Parkinson Foundation, New York City, New York, November 16.

Yoram Rudy, PhD, professor of engineering, cell biology and physiology, and of medicine, and research professor of radiology, spoke on "Noninvasive electrocardiographic imaging (ECGI) for cardiac electrophysiology and arrhythmia" at the International Dead Sea Symposium on Consensus and Controversy in Cardiac Arrhythmias, Tel Aviv, Israel, October 16. He presented "Cardiac repolarization and arrhythmia: mechanic insights from computational biology" at the Department of Medicine and Cardiovascular Research Center, University of Iowa, Iowa City, December 1. He spoke

#### Scott Lecture

h

Daniel Sullivan, MD, associate director of the National Cancer Institute's (NCI's) Division of Cancer Treatment and Diagnosis and head of the NCI's Cancer Imaging Program, was guest lecturer for the Thirty-fifth Annual Wendell G. Scott Memorial Lecture on October 11. He spoke on "Imaging in the era of molecular medicine."



Sullivan (right) received a commemorative plaque from Gilbert Jost, MD, chair of the Department of Radiology and director of Mallinckrodt Institute.

#### LECTURES

#### Continued from page 33

on "Modeling the molecular basis of repolarization and imaging atrial activation" at the International Workshop on Computer Simulation and Experimental Assessment of Electrical Cardiac Function, Lausanne, Switzerland, December 11.

Barry Siegel, MD, professor of radiology and of medicine, spoke on "PET in oncology: diagnosis"; "PET in oncology: beyond FDG"; and "PET in oncology: monitoring and predicting response to therapy" at the 4th Annual Practical PET Imaging 2006: A Focus on PET and PET-CT, Las Vegas, Nevada, October 20 and 21. He presented "Cancer diagnosis and staging with FDG-PET"; "FDG-PET in gynecologic cancers"; "FDG-PET in breast cancer"; "Monitoring cancer therapy with FDG-PET"; and "PET in oncology: beyond FDG" at the 2nd Chilean Congress of Nuclear Medicine, sponsored by the Chilean Society of Nuclear Medicine, Vina del

Mar, Chile, November 9-11. He spoke on "PET and PET/CT in clinical oncology" at Mercy Medical Center, Durango, Colorado, December 19.

#### Marilyn Siegel, MD,

professor of radiology and of pediatrics, presented "CT of congenital pulmonary anomalies," "Pediatric hepatic CTA," "CTA of congenital heart disease," and "Whole body MRI" at Pediatric Radiology: Basic Practice and Advanced Concepts, sponsored by Harvard Medical School, Boston, Massachusetts, October 6 and 7. She spoke on "CT/MR of pediatric renal tumors"; "Pediatric adrenal masses: multimodality imaging"; and "Bone marrow MRI" at the 22<sup>nd</sup> National Congress of Radiology, Monterrey, Mexico, October 13 and 14. She spoke on "Barriers to imaging in clinical trials" at the Cancer Imaging Program of the National Cancer Institute, Washington, DC, October 23 and 24.

#### Yuan-Chuan Tai, PhD,

assistant professor of radiology, presented a course on Small Animal Imaging: **Detectors and Technical** Aspects and spoke on "Generalized 3D kernel computation method and its application in PET-insert system" and "A prototype micro-insert for MicroPET F-220 and its initial performance" at the 2006 Institute of Electrical & Electronic **Engineers Nuclear Science** Symposium and Medical Imaging Conference, San Diego, California, October 29-November 4.

Lawrence Tarbox, PhD, research assistant professor of radiology, as breakout session chair, presented "Open architecture and software tools" at Imaging as a Biomarker: Standards for Change Measurements in Therapy, sponsored by the National Institute of Standards and Technology/U.S. Measurement System, Gaithersburg, Maryland, September 14 and 15.

#### Franz Wippold, MD,

professor of radiology, presented "Stem cell research: observations and reflections" at Barnes-Jewish Hospital Medical Staff Grand Rounds, St. Louis, Missouri, October 5.

#### Symposia

In this section of FYI, only those faculty and staff who have Department of Radiology appointments are listed. Setl

Max

Wor

cool

targ

bact

livin

Shir

Piw

"Bio

curc

bitic

Shi

Piw

"Bio

of s

gene

Shi

Pric

Woi

uou

by in

pum

biol

luci

Apa

Piw

"Dy

indu

and

biol

And

Juli

Piw

"Im

inte

tran

Day

MD PhI

gen

hea

cell

#### SOCIETY FOR MOLECULAR IMAGING

5th Annual Meeting Waikoloa, Hawaii August 30-September 2, 2006

Samuel Achilefu, PhD; Joseph Ackerman, PhD; Carolyn Anderson, PhD; David Piwnica-Worms, MD, PhD; Michael Welch, PhD, members, Scientific Program Committee.

**Shimon Gross, PhD**, recipient, Young Investigators Award.

#### SCIENTIFIC PROGRAM

Kristin Bullok; David Piwnica-Worms, MD, PhD, "Visualization of effector caspase activity in rat models of retinal ganglion cell apoptosis using an activatable fluorescent permeation peptide."

Joseph Culver, PhD; Samuel Achilefu, PhD; Sachin Patwardhan, PhD, "High-frequency diffuse optical tomography for quantitative imaging in small animals."

Seth Gammon; Victor Villalobos; David Piwnica-Worms, MD, PhD, "Rational design of a single chain biosensor D-luciferin for imaging executioner caspase activity."

#### Alumni News

**Arthur Bishop, MD**, a staff member of Methodist Medical Center of Illinois, Peoria, died on February 11, 2007. He received his medical degree from the University of Illinois at Chicago and was a diagnostic radiology resident at Mallinckrodt Institute (1977-1981). Dr. Bishop was recognized in 2006 by the General Electric Medical Systems division for his commitment to excellence in the field of interventional radiology. He is survived by his wife Susan.

Memorial contributions may be made to the Methodist Medical Center Foundation, 120 Northeast Glen Oak Avenue, Peoria, Illinois 61603; Attn: Dr. Arthur Bishop Radiology Department CE Scholarship. Donations also may be made to the American Cancer Society in memory of Dr. Bishop.

# FY

Seth Gammon; Dustin Maxwell; David Piwnica-Worms, MD, PhD, "Zinc (II) coordination complexes target fluorescent probes to bacteria both in vitro and in living mice."

Shimon Gross, PhD; David Piwnica-Worms, MD, PhD, "Bioluminescence imaging of curcumin-induced IKK inhibition in colon carcinoma."

Shimon Gross, PhD; David Piwnica-Worms, MD, PhD, "Bioluminescence imaging of spontaneous lymphomagenesis."

Shimon Gross, PhD; Julie Prior; David Piwnica-Worms, MD, PhD, "Continuous delivery of D-luciferin by implanted micro-osmotic pumps enables true real-time bioluminescence imaging of luciferase activity in vivo."

Aparna Kesarwala; David Piwnica-Worms, MD, PhD, "Dynamic analysis of ligandinduced EGFR processing and regulation by real-time bioluminescence imaging."

Andrea Pichler, PhD; Julie Prior; David Piwnica-Worms, MD, PhD, "Imaging protein-protein interactions in a Ga 14->Fluc transgenic reporter mouse."

David Piwnica-Worms, MD, PhD; Buck Rogers, PhD, "Heat-activated transgene expression in human head and neck squamous cell carcinoma."

11

Kooresh Shoghi, PhD, "In silico discovery and profiling of molecular imaging probes for myocardial substrate utilization in the diabetic heart through metabolic flux analysis."

**Amy Vavere; Jason Lewis, PhD**, "Relationship of Cu-ATSM hypoxia selectivity and fatty acid synthase activity in prostate tumor models."

Victor Villalobos; Snehal Naik; David Piwnica-Worms, MD, PhD, "Novel two-color luciferase complementation systems for imaging protein-protein interactions in live cells and animals."

Yunpeng Ye, PhD; Sharon Bloch, PhD; Walter Akers; Baogang Xu; Michael Welch, PhD; Samuel Achilefu, PhD, "Novel DFO-bearing RGD compounds for targeting tumor."

#### SOCIETY FOR NEUROSCIENCE

36th Annual Meeting Atlanta, Georgia October 14-18, 2006

**Maurizio Corbetta, MD**, chair, Search and Attention I Session.

Mark Mintun, MD, chair, Radiological Imaging of Neurodegenerative Disease II Session.

#### **SCIENTIFIC PROGRAM**

Deanna Barch, PhD; Melissa Rundle; Mark Mintun, MD; Abraham Snyder, MD, PhD; Yvette Sheline, MD, "Emotional conflict processing in major depression reflects disturbances in both affective and cognitive control circuitry."

Kevin Black, MD, "Quantitatiuve pharmacodynamic neuroimaging by a novel method."

Randy Buckner, PhD; Bradley Schlaggar, MD, PhD; Steven Petersen, PhD, "Functional-anatomic study of the human lifespan ages 9-92."

Nico Dosenbach; Francis Miezin; Michael Fox; Abraham Snyder, MD, PhD; Justin Vincent; Marcus Raichle, MD; Bradley Schlaggar, MD, PhD; Steven Petersen, PhD, "Graph analysis and clustering of resting functional connections identify separable task control networks."

Adrian Epstein; Joshua Shimony, MD, PhD; Abraham Snyder, MD, PhD; Robert McKinstry, MD, PhD; Mark Mintun, MD; Asif Moinuddin, MD; Jon Christensen; Yvette Sheline, MD, "Frontal lobe abnormalities in normal appearing white matter in late-life depression using diffusion tensor imaging." Michael Fox; Abraham Snyder, MD, PhD; Justin Vincent; Marcus Raichle, MD, "Coherent spontaneous activity accounts for trial-totrial variability in human behavior."

Tamara Hershey, PhD; Joel Perlmutter, MD; Tom Videen, PhD, "Development of an atlas-based registration method for active contact localization in deep brain stimulation (DBS) of subthalamic nucleus (STN) in Parkinson's disease (PD)."

Linda Larson-Prior, PhD; Justin Vincent; Tracy Nolan; Abraham Snyder, MD, PhD; Marcus Raichle, MD, "An EEG-fMRI study of the default network in light sleep."

David Loy, MD; Joong Hee Kim; Sheng-Kwei Song, PhD, "Diffusion tensor imaging: A promising diagnostic tool for stratification of hyperacute spinal cord injury severity."

Robert Mach, PhD; Zhude Tu, PhD; Wenhua Chu, PhD; Jinbin Xu; Shihong Li; Lynne Jones; Carmen Dence, MS; Joel Perlmutter, MD; Mark Mintun, MD, "In vivo evaluation of ["C]WC-10: a novel radiotracer for imaging dopamine D3 receptors."

Francis Miezin; Nico Dosenbach; Michael Fox; Abraham Snyder, MD, PhD; Justin Vincent; Marcus Raichle, MD; Steven Petersen, PhD; Bradley Schlaggar, MD, PhD, "A method for using task-related data to study 'resting state' functional connectivity."

#### SYMPOSIA

Continued from page 35

Francis Miezin; Nico Dosenbach; Michael Fox; Abraham Snyder, MD, PhD; Justin Vincent; Marcus Raichle, MD; Bradley Schlaggar, MD, PhD; Steven Petersen, PhD, "The effect of movement on functional connectivity in children and adults."

Mark Mintun, MD; Abraham Snyder, MD, PhD; Lars Couture; William Powers, MD; Russ Hornbeck; Tom Videen, PhD; Lori McGee-Minnich, RN; Joel Perlmutter, MD; Robert Mach, PhD; Marcus Raichle, MD, "Distribution of glycolysis in the resting healthy human brain correlates with distrubution of beta-amyloid plaques in Alzheimer's disease."

**Jeffrey Neil, MD, PhD; Harold Burton, PhD,** "Thalamocortical tract formation in ferrets: a diffusion MRI study."

Steven Petersen, PhD; Bradley Schlaggar, MD, PhD, "Regions showing developmental effects in reading studies show length and lexicality effects in adults."

William Powers, MD; Tom Videen, PhD; Joanne Markham; Lori McGee-Minnich, RN; Tamara Hershey, PhD; Joel Perlmutter, MD, "Normal in vivo mitochondrial oxidative metabolism in early Huntington's disease striatum." Melissa Rundle; Mark McAvoy, PhD; Mark Mintun, MD; Robert McKinstry, MD, PhD; Yvette Sheline, MD, "A new paradigm to investigate taste responses in humans using fMRI."

Yvette Sheline, MD; Melissa Rundle; Deanna Barch, PhD; Mark Mintun, MD, "Regulation of emotion in depression."

Abraham Snyder, MD, PhD, "Effects of amygdala or hippocampal lesions on resting brain metabolism in the macaque monkey."

Abraham Snyder, MD, PhD; Justin Vincent; Randy Buckner, PhD, "Spontaneous correlations and the default network: Effects of Effects of amygdala or hiptask performance."

Abraham Snyder, MD, PhD; Justin Vincent; Michael Fox; Marcus Raichle, MD; Randy Buckner, PhD, "Evidence for large-scale network disruption in advanced aging."

Abraham Snyder, MD, PhD; Justin Vincent; Gordon Shulman, PhD; Maurizio Corbetta, MD, "Breakdown of frontoparietal functional connectivity characterizes spatial neglect."

**Sheng-Kwei Song, PhD**, "Diffusion tensor imaging changes in injured white matter following experimental traumatic brain injury: a time course study." Sanjeev Vaishnavi; Justin Vincent; Abraham Snyder, MD, PhD; Michael Fox; Marcus Raichle, MD, "Effect of motor learning on spontaneous fMRI fluctuations."

Justin Vincent; Gaurav Patel, MD; Michael Fox; Abraham Snyder, MD, PhD; Jonathan Baker, MD; Marcus Raichle, MD, Maurizio Corbetta, MD, "The functional connectivity of spontaneous fMRI BOLD fluctuations in FEF and LIP of the monkey and human."

Jinbin Xu; Wenhua Chu, PhD; Suwanna Vangveravong; Lynne Jones; Jason Lewis, PhD; Joel Perlmutter, MD; Mark Mintun, MD; Robert Mach, PhD, "Quantization of dopamine D<sub>3</sub> receptors in the monkey and rat striatum using the novel D<sub>3</sub> ligand [<sup>s</sup>H]WC-10."

Mingming Zhu; Joseph Ackerman, PhD; Dmitriy Yablonskiy, PhD, "The temperature shielding effect of cerebral blood flow."

#### WORLD FEDERATION OF NUCLEAR MEDICINE AND BIOLOGY

9th Congress Seoul, Republic of Korea October 22-27, 2006

Michael Welch, PhD, chair, Molecular Imaging Seminar; coordinator, Radiochemistry/Radiopharmaceutical Track.

#### SCIENTIFIC PROGRAM Carmen Dence, MS;

Michael Welch, PhD, "Synthesis and in vivo characterization of F-18 and Br-76 labeled non-steroidal androgens."

Carmen Dence, MS; Hsiaoju Lee; Robert Mach, PhD; Michael Welch, PhD, Synthesis of F-18 labeled ligands for the peroxisome proliferator-activated receptor gamma (PPAR Gamma), potential positron emission tomography (PET) agents for imaging lipid metabolism and cancer." (Winner of the Masahiro Iio Award for most outstanding paper)

Carmen Dence, MS; Robert Mach, PhD; Micheal Welch, PhD, "Synthesis of F-18 labeled sigma-2 receptor ligands as potential PET imaging agents using F-18 labeled 4-fluorobromobenzene."

Michael Welch, PhD, "New PET radiopharmaceuticals and their applications."

Fountains on the 50,000 square-foot pedestrian promenade (the Grand Concourse) at McCormick Place Chicago, site of the 92nd annual meeting of the Radiological Society of North America.

eh, ), g-

m he

w