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Autumn 2011

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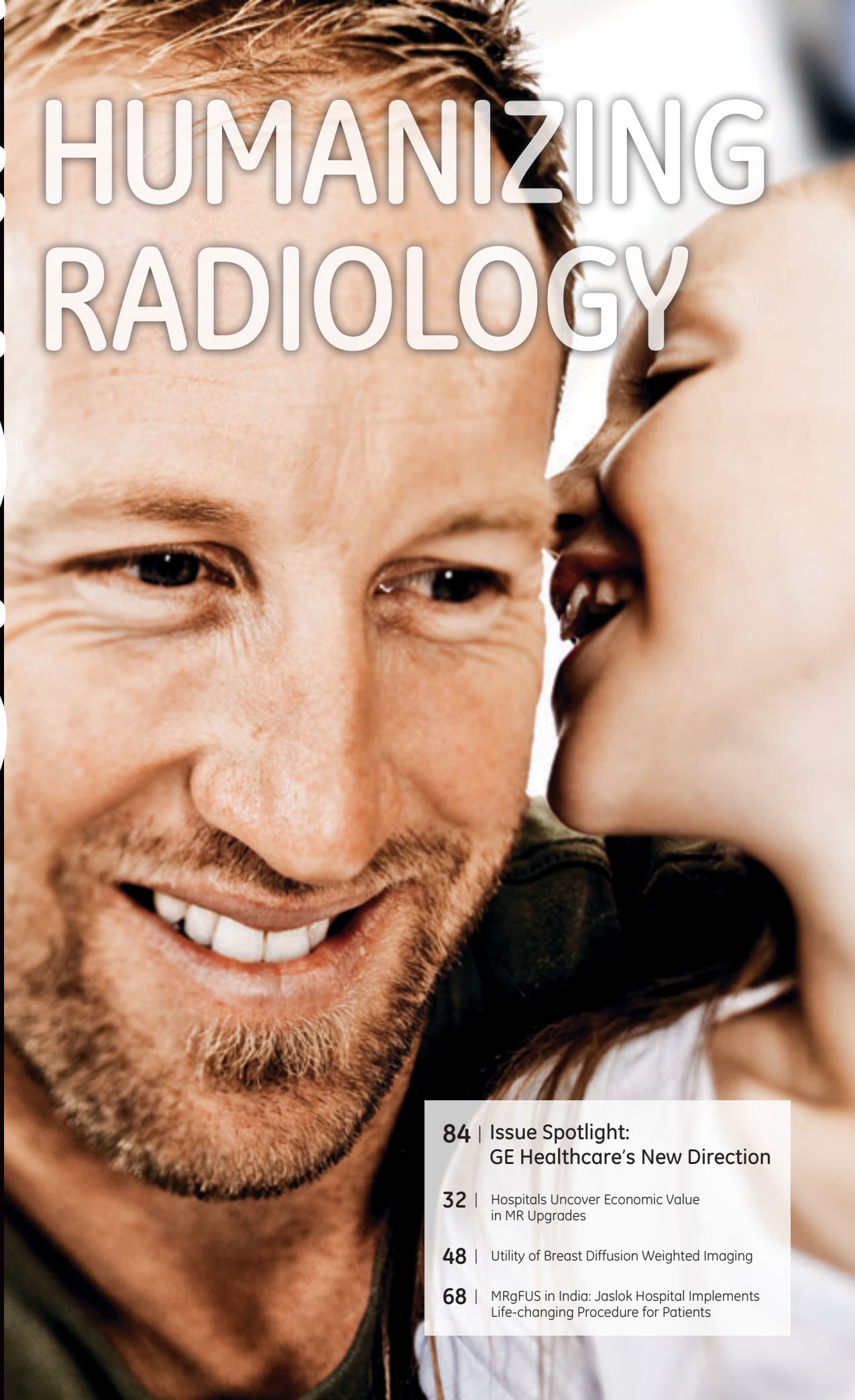
Volume Eleven



HUMANIZING RADIOLOGY

WELCOME

James E. Davis

As we mark the five-year anniversary of SignaPULSE, we're reflecting on how GE Healthcare has introduced technology with a caring purpose—from 10 new MR systems to innovative new applications all in just the last five, exciting years. While providing patients, technologists, radiologists, and administrators with exceptional technology has always been a top priority, we are constantly mindful of the human element.

To this end, we are formalizing a mission that we have been on for the past five years—optimizing the patient experience while continuing to provide superb image quality.

For the upcoming Radiological Society of North America (RSNA) Annual Meeting, we challenged ourselves to select a theme—"Humanizing Radiology"—that's in line with our new direction and more impactful than ever before. We're especially excited to talk about our new wide bore series, the Discovery* MR750w and Optima* MR450w with the GEM Suite of coils, offering a balance of caring design and insightful technology. They bring together the versatility of 1.5T and the performance of 3.0T while representing our focus on the human element in MR.

We're also unveiling new patient-centric innovations; for example, GEM-enabled workflow, MultiDrive RF Transmit, IDEAL IQ, and integrated solutions to help improve the overall patient experience (see pages 60–67).

Additionally, we're challenging ourselves to improve the value of the clinical, technical, and practice-related information delivered to you in this magazine. We formed an editorial board to elevate our clinical and technical content (see pages 5–6). Also, we've enhanced the publication's look, feel, and "user friendliness," including the addition of industry tips and exclusive digital-only content. We hope the changes help you feel more intimately connected to the GE Healthcare MR Community.

We expect our new path will continue to produce the kind of innovations you have come to expect from us. Innovations that provide a clinical impact and successfully emphasize the human element in radiology.

We ask you to join us on our mission to humanize radiology. As always, we want to hear your ideas. Together we will improve healthcare—for patients and caregivers.

Let's start at RSNA! I look forward to seeing you.

James E. Davis

James E. Davis
Vice President and General Manager,
Global MR Business, GE Healthcare

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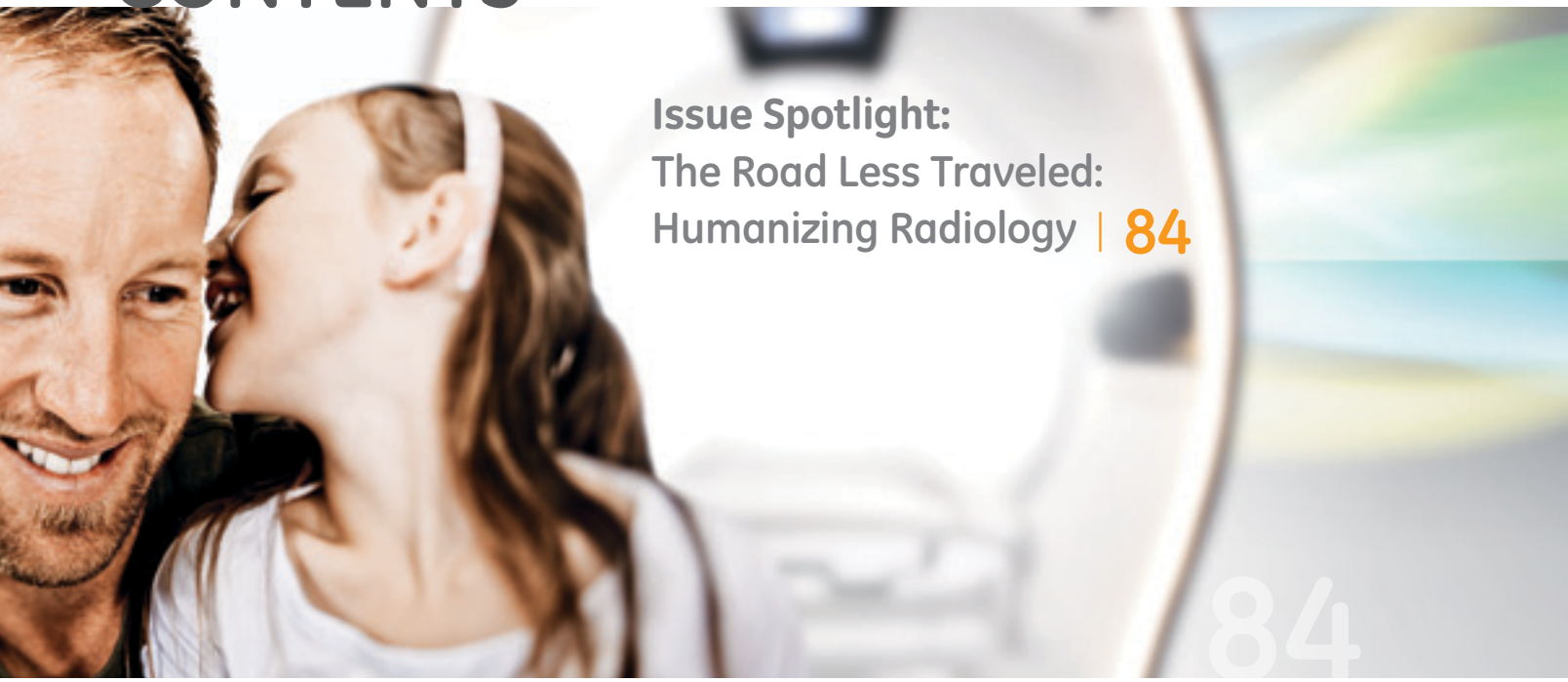

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General Manager, Premium & Interventional MR, Waukesha, Wisc.

Education: Physicist (Degrees: MSc in the Netherlands, PhD in Germany)

Work history at GE Healthcare: joined in March 2009 in current position

Professional milestones/achievements:

- Worked in MR since 1985
- With Philips, worked as CT Research Scientist, MR Clinical Scientist, MR Product Manager, MR Sales Leader, VP MR Global Marketing, and VP Oncology Global Marketing

Something interesting about Jacques: lived in the Netherlands, Germany, and in many states in the US; avid history/archeology/architecture lover; and founding member of MROX band

Takeshi Fujita

Asia Pacific MR Business GM, Tokyo, Japan

Education: Bachelor of Political Science, Keio University, Japan

Work history at GE Healthcare: joined GE in 1999; Six Sigma: Master Black Belt Certified; Japan Diagnostic X-Ray Sales and Marketing GM; Japan MR Sales and Marketing GM; and Asia Pacific MR Business GM

Professional milestones/achievements:

- Spending most of GE career in business leader role with sales and marketing background
- Currently responsible for 11 countries in Asia Pacific

Something interesting about Takeshi: loves baseball, traveling, and reading books

Dave Dobson

Global Marketing Leader, Global MR, Waukesha, Wisc.

Education: Masters of Healthcare Administration & Bachelor of Science in Marketing

Work history at GE Healthcare: 14 years GE experience in finance, sales, and marketing functions at GE Healthcare, GE Insurance, & GE Industrial Systems

Professional milestones/achievements: as the former marketing leader for Children's Health, Dave was a founding developer of the GE Adventure Series experience solution and worked closely with the Society for Pediatric Radiology on the creation of the Image Gently dose awareness and education program.

Something interesting about Dave: proud father of two boys, David (8) and Matthew (6), who enjoy playing football, going fishing, and camping with Dad

Karthik Kuppusamy, PhD

General Manager, Global MR Research & Applications, Waukesha, Wisc.

Education: PhD—Washington University; MBA—Marquette University; MS—Indian Institute of Technology, Madras

Work history at GE Healthcare: in the healthcare industry for the past 20 years, GE experience includes: Scientist & Manager of MR Neuro Applications; Global Product Manager for 1.5T MR segment & Excite Technology; Global Advanced Development Manager for CT, PET, NM, Cyclotrons; General Manager, Sales & Marketing for Molecular Imaging, USA; and General Manager, Sales & Marketing for CT, USA

Professional milestones/achievements:

- 2004–2005, Secretary of Academy of Molecular Imaging
- 2006–2007, led team to achieve PET/CT excellence in the US market
- 2007, GE CEO award for Leadership and Growth in Diagnostic Imaging

Something interesting about Karthik: passionate about playing tennis and cricket, successfully learned to swim after turning 40; proud father of Sneha (12) and Sowmya (7)

Roee Lazebnik, MD, PhD

Chief Medical Officer, Global MR, Waukesha, Wisc.

Education: MD and PhD (Biomedical Engineering)—Case Western Reserve University

Work history at GE Healthcare: in healthcare industry for 13 years. GE experience includes leading and supporting the medical, clinical, and evidence generation strategies, as well as the patient safety and medical risk assessment process across MR

Previous roles:

- Sr. Dir. Product Mgmt. and Med Affairs, Siemens
- Global Radiology and OB/Gyn Seg. Mgr., Siemens
- Housestaff Physician, Stanford Medical Center

Professional milestones/achievements: clinical trial and evidence generation, healthcare provider and market interactions, patient safety initiatives, and strategic business leadership

Something interesting about Roee: interests include travel and creative writing

Jason A. Polzin, PhD

Chief Engineer, Software and Applications, Global MR, Waukesha, Wisc.

Education: PhD, University of Wisconsin-Madison in Medical Physics

Work history at GE Healthcare: with the GE Healthcare MR business since 1995. Spent the first five years in engineering to bring a number of features to product including efgre3d, SmartPrep, FastCard PC, FastCine, and SmartStep; In 2001, joined the Applied Science Laboratory to work closely with GE's research partners in the central US and Canada. In 2004, returned to engineering to take the role of Chief Engineer for the MRI business. Responsible for technology risk retirement and feasibility in collaboration with engineering, ASL, the Global Research Center, and external research partners

Something interesting about Jason: inventor on 26 US Patents related to MRI

MRI Technology Introduced to New Markets

The healthymagination-validated Brivo* MR355 and ecomagination-validated Optima* MR360 from GE Healthcare were introduced to the Latin America market at the 41st JPR Sao Paulo Radiological Meeting—the largest diagnostic imaging event in Latin America, and the fourth largest in the world. The event was held April 28–May 1, 2011 in Sao Paulo, Brazil.

The show gathered more than 14,000 healthcare professionals, physicians, scientists, industry contributors, and key opinion leaders from Brazil and other countries in Latin America. GE Healthcare shared its healthymagination commitment to deliver high-quality healthcare at lower cost to more people around the world.

In summer, 2011 the Brivo MR355 and Optima MR360 received SFDA approval in China. A celebratory launch followed in Beijing, focusing on how the Optix technology will allow providers to step up to a premium 1.5T MR scanner—bringing high-field MR, uncompromised image quality, versatility, and flexibility within reach.

DIGITAL DIVE
For more information, visit www.healthymagination.com and www.ecomagination.com

Discovery MR750 Installed in South Asia

South Asia's first installation of Discovery* MR750 from GE Healthcare took place in Summer 2011 at Max Super Specialty Hospital in Delhi, India. Max Healthcare is the country's leading comprehensive provider of standardized, seamless, and international-class healthcare services. Max Healthcare is one of the leading healthcare providers in India with 10 hospitals, more than 1,250 leading doctors, 3,000 employees, and beds growing to over 1,900 in the next three years.

First Inductee: GE Reports Genius Hall of Fame

Dr. John Schenck is the first inductee into the GE Reports Genius Hall of Fame, which recognizes seasoned innovators creating world-changing technology at GE. Dr. Schenck was a member of the GE research team that first developed the clinically viable MRI scanner. Since then, more than 500 million MRI images have been made.

Schenck is still hard at work at the GE Research Lab in New York. He spoke about the early days of medical imaging and the tech breakthroughs he's most excited about today.

SignaPULSE Goes Digital

The SignaPULSE magazine app is now available for free download on the iPad, iPhone, and Android. Digital readers can search issues for key words, e-mail articles as a simple URL for download, read exclusive digital stories, and experience rich media content. The digital version automatically formats itself for the device's screen. Give it a try!

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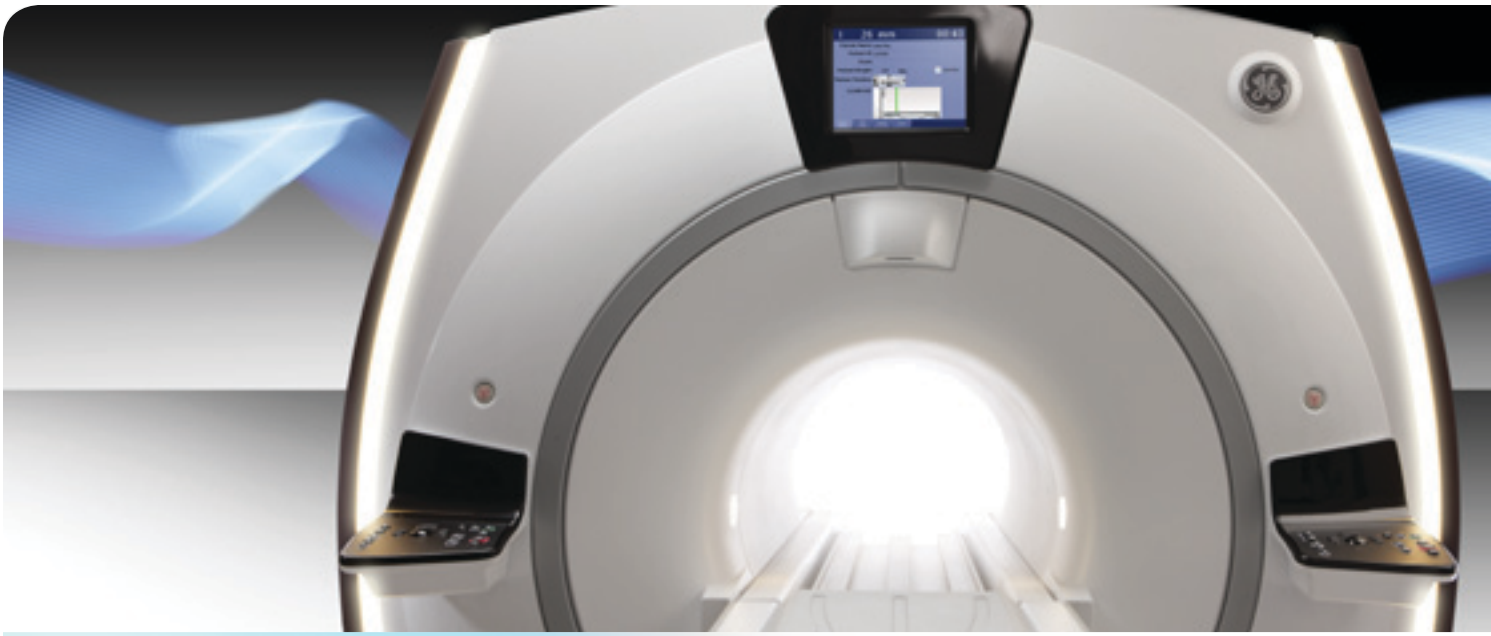


Discovery MR750w Gets FDA Nod

GE Healthcare has received FDA clearance of the Discovery* MR750w wide bore, 3.0T system with GEM (Geometry Embracing Method) Suite of Coils.

The new system addresses patient demand for a better and more comfortable scanning experience. In particular, the new patient-friendly design accommodates patients who are usually difficult to scan, such as larger, claustrophobic, elderly, or young patients, or those who are in pain and require a larger imaging system. Additionally, the system combines next-generation clinical applications and a full 50 x 50 x 50 cm FOV with excellent homogeneity, and enables users to reduce exam time and scan large anatomies with fewer scans—compared to previous generation systems. It helps enable higher patient throughput and satisfaction.

DIGITAL DIVE
For more information, visit www.tiny.cc/vmhxu or visit http://www.youtube.com/watch?v=GwFBMW2oxU4 to view the MR750w product video

Design Excellence Awards for MRI

GE Healthcare received several Silver Awards from the 2011 International Design Excellence Awards for MRI by the Industrial Designers Society of America—considered by many as the "Oscars" of design competitions because the judging process is rigorous with the judging panel consisting of experts in the field.

Chosen from over 2,000 entries from 39 countries, GE Healthcare won three IDEA Silver Awards—for the Discovery* MR750w, featuring the system's unique caring design and insightful technology, a pediatric MRI scanner concept called Nino‡‡, and an extremity‡‡ MRI concept.

The jury, made up of 20 international design experts, spent weeks previewing entries online and two-and-a-half days of face-to-face evaluation and debate. Judging criteria focused on eight areas of industrial design excellence: innovation; benefit to the user; benefit to society; benefit to the client; visual appeal and appropriate aesthetics; usability, emotional factors, and unmet needs for the design research category; and internal factors, methods, strategic value, and implementation for the design strategy category.

DIGITAL DIVE
For more information, visit www.tiny.cc/bsorh or www.idsa.org.

‡‡ Technology in development that represents ongoing research and development efforts. These technologies are not products and may never become products. Not for sale. Not cleared or approved by the FDA for commercial availability.

Studying Parkinson's Disease

An Australian study into Parkinson's disease is using the Discovery* MR750 and virtual reality to help unlock this medical mystery. Eighty thousand Australians have Parkinson's Disease[1], often typified by tremors, but 50% also have sudden freezing of motion—described as if their legs are glued to the floor[2].

No surgery adequately treats this freezing. According to Dr. Simon Lewis, neurologist with the Brain and Mind Research Institute at the University of Sydney, this often happens when people are trying to multitask. Dr. Lewis hypothesized that it's not a problem with muscles but with brain function.

As part of a study at the Parkinson's Disease Research Clinic, Dr. Lewis' team provides Parkinson's patients with functional MRI (fMRI) scans as the patients push foot pedals—simulating walking while negotiating a virtual corridor of doors and thinking puzzles. As they "walk," the brain area controlling movement lights up and becomes active. When the feet lose their activity, the corresponding areas of the brain go cold—creating an enormous surge in the rest of the brain while trying to overcome the problem.

Moving forward, patients will be exposed to exercises to try and trick the brain, using a virtual world which is much safer than the real world. Tapping into this brain activity using fMRI is expected to lead to new therapies and hope for those affected.

1. One in every 350 Australians lives with Parkinson's Disease. Parkinson's Australia Inc. 12 October 2011.
2. Giladi N, McDermott MP, Fahn S, et al. Freezing of gait in PD: prospective assessment in the DATATOP cohort. Neurology 2001; 56: 1712-1721

First Traumatic Brain Injury Treatment Certification

San Francisco General Hospital and Trauma Center has become the first hospital in the country to gain certification for the treatment of traumatic brain injury, after an intensive on-site visit by the Joint Commission—a national independent organization that accredits hospitals and offers disease-specific certifications. The certification was based on medical skills, neuro-monitoring capabilities, research, and imaging technologies—including MRI. GE Healthcare collaborated with the hospital to provide the majority of its imaging equipment, including two GE Signa* HDxt 1.5T scanners.

For more information about traumatic brain injury, see page 89.

‡‡ Artist's impression. Technology in development that represents ongoing research and development efforts. These technologies are not products and may never become products. Not for sale. Not cleared or approved by the FDA for commercial availability.

Researching Dedicated MRI Brain Scanner Technology

GE Global Research, the technology development arm for GE, and Mayo Clinic, have received a five-year, $5.7 million grant from the National Institute of Biomedical Imaging and Bioengineering, and the National Institute of Neurological Disorders and Stroke, both components of the National Institutes of Health. They will jointly conduct research to understand design and application issues involved in the use of a dedicated MRI brain scanner‡‡ to image for a range of neurological and psychiatric disorders such as stroke, Alzheimer's Disease, Parkinson's Disease, traumatic brain disorder, depression, and autism.

The intention is that a dedicated high-field scanner could offer a more specialized imaging approach and a greater range of functionality for neurological imaging compared to the current one-size-fits-all concept of whole-body MRI. The goal of the program is ultimately to understand and address the technical issues involved in dedicated MR imaging of the brain.

DIGITAL DIVE
For more information on the dedicated MRI brain scanner, visit www.tiny.cc/nygdr

‡‡ Technology in development that represents ongoing research and development efforts. These technologies are not products and may never become products. Not for sale. Not cleared or approved by the FDA for commercial availability.

First Radiation Oncology User Meeting

The first GE Healthcare MR Radiation Oncology User Meeting was held in Rotterdam, the Netherlands on September 14–15, 2011 with a great deal of participant enthusiasm. The objectives were to share best practices, review new technologies, and explore areas of continuing challenge.

Approximately 25 of the leaders in this field were in attendance. The agenda included the use of MR for brain, head and neck, and prostate cancers, as well as MR-based treatment planning, advanced imaging techniques, quality assurance, and the MR-guided therapies of MRgFUS and MR-Linac.

Erasmus Medical Center hosted the event, allowing users to tour the new Optima* MR450w with GEM and the Radiation Oncology Suite—located in the Daniel Den Hoed Cancer Center and supporting imaging for cancer diagnosis, staging, treatment planning, and treatment monitoring. The system is one of the first to be installed in Europe and demonstrates GE Healthcare's commitment to radiation oncology.

First Installation of Optima MR430s

The world's first installation of Optima* MR430s took place in summer, 2011 at Balgrist University Hospital—a highly specialized center committed to excellence in all areas of musculoskeletal care—in Zurich, Switzerland.

The Optima MR430s is a new specialty scanner offering breakthrough technology that delivers precise imaging with exceptional comfort, and the 1.5T image quality radiologists require. The system is an extreme leap forward in MR imaging because only the targeted anatomy—whether it's an arm or a leg—goes inside the system. For more information, see page 75 (Beyond the Scan story).

More News You Don't Want to Miss:

- New MRI enables breakthrough surgeries at UW Hospital: page 21, (In Practice story).
- First Installation of New Optima* MR450w with GEM in Creil, France: page 60, (Tech Trends story).
- Introducing MultiDrive RF Transmit, offering consistently clear, personalized MR signal uniformity: page 66, (Tech Trends story).

COMPREHENSIVE ASSESSMENT OF BICUSPID AORTIC VALVE DISEASE BY CARDIOVASCULAR MR

By Sung Min Ko, MD, Department of Radiology, Konkuk University Hospital, Konkuk University School of Medicine

Bicuspid aortic valve (BAV) disease is the most common congenital cardiac malformation and is clinically important because of its association with aortic stenosis, aortic regurgitation, infective endocarditis, aortic aneurysm, aortic dissection, and aortic coarctation. An accurate assessment of the aortic valve morphology, the significant valve-related complications, the diameter of ascending aorta, and the extent and rate of progression of aortic dilatation is imperative in planning the surgery.

At our facility, we regularly use MR for cardiac imaging—more than 1,300 cardiac exams have been performed on a Signa* HDxt 1.5T MR scanner. Across the industry and MR systems, recent advancements in cardiovascular magnetic resonance (CMR) scanner technology and improvements of analyzing software help provide a comprehensive assessment of aortic valve morphology. These improvements include left ventricular volume and function, quantification of the severity of valvular dysfunction, and evaluation of thoracic aorta. Particularly, flow measurements with velocity-encoded Cine CMR show a good correlation with Doppler echocardiographic findings. Delayed contrast-enhanced CMR can identify myocardial scar in patients with severe aortic stenosis.

In our institution, CMR is used routinely in the preoperative assessment of valvular heart disease, particularly BAV. Patients

diagnosed with BAV typically underwent CMR and aortic valvuloplasty with or without ascending aorta wrapping or graft replacement. This paper demonstrates the clinical utility of CMR for imaging BAV disease accompanied with various related complications and other congenital cardiovascular malformations, and our new surgical technique of aortic valve repair.

BAV morphology assessment

FIESTA Cine CMR enables an accurate morphological differentiation between tricuspid and bicuspid aortic valves with a high interobserver agreement as compared to echocardiography, particularly in patients with severe valve calcification.

Patient case

A 47 year-old man with a calcified bicuspid aortic valve. Double-oblique CT axial image in systole shows a heavily calcified, thickened, and stenosed bicuspid aortic valve (Figure 1A). Double-oblique FIESTA Cine CMR image in systole clearly depicts a severely stenosed and thickened bicuspid aortic valve (Figure 1B). The type of aortic valve is not clearly identified by transthoracic echocardiography due to severely calcified cusps (Figure 1C).

Figure 1A.

Figure 1B.

Figure 1C.

Aortic stenosis

The most common complication of BAV is aortic stenosis. The aortic valve morphology, motion, and area assessment using CMR is possible with good image quality in patients with calcified BAV stenosis. CMR visualizes turbulent blood flow through a stenotic aortic valve with quantification of blood flow and peak velocity for assessing the preoperative presence of myocardial scar or fibrosis.

Patient case

Severe aortic stenosis in a 48 year-old man with BAV. Double oblique axial FIESTA Cine CMR image in systole clearly demonstrates BAV with a severely reduced opening area measuring 0.81 cm^2 (Figure 2A). Axial T1-weighted spin echo CMR shows concentric hypertrophy of the left ventricular myocardium (Figure 2B). Vertical long-axis delayed CMR image shows diffuse areas of delayed hyperenhancement in the transmural apical to mid anterior and apical inferior, and subendocardial mid to basal inferior left ventricular myocardium, corresponding to myocardial fibrosis (Figure 2C). Three-dimensional CMR angiogram of the thoracic aorta demonstrates a fusiform aneurysm of the descending aorta (Figure 2D).

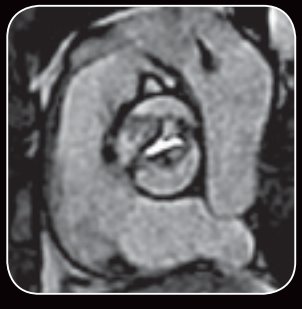
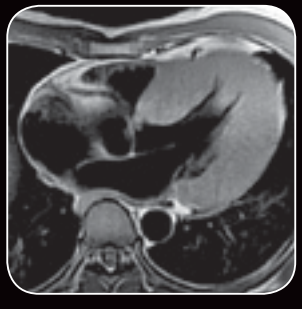


Figure 2A.



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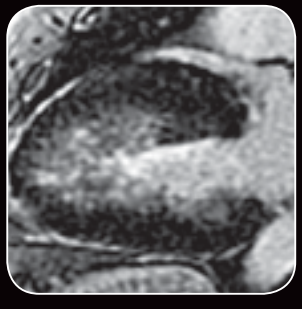

Figure 2C.

Figure 2D.

Sung Min Ko, MD, PhD,
is an Associate Professor in the Division of Cardiothoracic Imaging, Department of Radiology, at Konkuk University School of Medicine and Konkuk University Hospital.

Aortic regurgitation

Aortic regurgitation in a BAV occurs more commonly in younger patients. FIESTA Cine CMR visualizes aortic regurgitation and allows quantitative evaluation by direct planimetry of the aortic regurgitant orifice. In addition, CMR provides assessments of regurgitant volume and flow.

Patient case

Severe aortic regurgitation in a 45 year-old man with BAV. Double-oblique CT axial image in diastole shows failure of coaptation of BAV with regurgitant orifice area measuring 0.63 cm^2 (Figure 3A). Transthoracic echocardiogram (Figure 3B) and double-oblique balanced-steady state precession coronal Cine CMR image (Figure 3C) demonstrate severe regurgitant jet flow through BAV in diastole. Velocity-encoded Cine CMR confirms severe aortic regurgitation with regurgitant fraction 48% (Figure 3D).

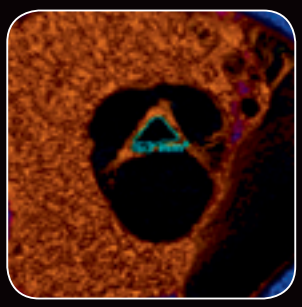

Figure 3A.

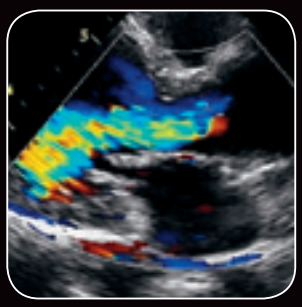

Figure 3B.

Figure 3C.

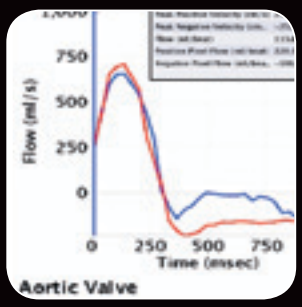

Figure 3D.

Aortic complications

It is estimated that aortic dissection occurs five to 10 times more frequently in patients with BAV than in those with tricuspid aortic valve due to the higher prevalence and rate of aortic dilatation. CMR has become the preferred imaging modality for the evaluation of the thoracic aorta, particularly the ascending aorta diameter and coarctation of aorta in patients with BAV.

Patient case

Ascending aorta aneurysm in a 40 year-old man with severe BAV stenosis. Double-oblique CT axial image with thick slab volumetric, four-dimensional reconstruction using a blood pool inversion technique clearly demonstrates heavily calcified BAV cusps with no raphe. Note the severely reduced opening in systole. The aortic valve area measures 0.68 cm^2 (Figure 4A). Double-oblique coronal FIESTA Cine CMR image in early systole shows thickened aortic valve cusps with severely reduced opening (Figure 4B). Double-oblique CT (Figure 4C) and FIESTA Cine CMR (Figure 4D) images show dilated aortic root and aneurysm (diameter of 61 mm) of ascending thoracic aorta. Diameters of ascending aorta measured by CT and CMR are well correlated in this case.

Figure 4A.

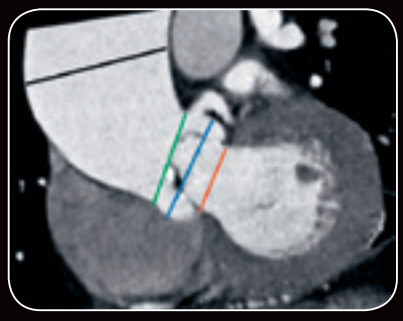

Figure 4C.

Figure 4B.

Figure 4D.

Figure 5A.

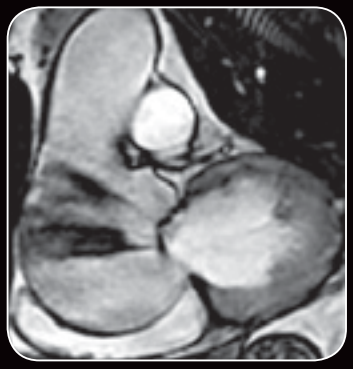

Figure 5B.

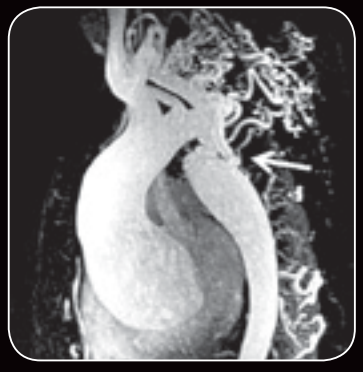

Figure 5C.

Associated congenital cardiovascular malformations

The BAV may coexist with other congenital cardiovascular malformations and accounts for a significant morbidity when linked with these congenital malformations. Approximately 50% to 70% of patients with coarctation of aorta (COA) have a BAV. Patients with both COA and BAV are more likely to develop aortic stenosis, aortic regurgitation, and ascending aorta aneurysm and dissection. CMR provides precise delineation of the cardiovascular anatomy, quantitative assessment of cardiac function, including severity of stenosis in COA, supravalvular and subvalvular aortic stenosis, calculation of collateral flow in COA, and quantification of pulmonary-to-systemic flow ratio (Qp/Qs) in ventricular septal defect.

Patient case

Coarctation of aorta and aortic sinus aneurysm in a 49 year-old man with BAV. Double-oblique axial FIESTA Cine CMR image in systole demonstrates a BAV with severe aortic stenosis (Figure 5A). Double-oblique coronal FIESTA Cine CMR shows turbulent jet flow and aneurysm with a diameter of 71 mm involving sinus of Valsalva (Figure 5B). The three-dimensional MR angiogram demonstrates a severe, discrete, juxtaductal coarctation of aorta (arrow) on the maximum intensity projection (Figure 5C).

Pre- and post-surgical evaluation of BAV with CMR

A comprehensive aortic root and valve reconstruction (CARVAR) procedure is a new surgical technique which is comprised of aortic root wall reconstruction and corrections of the leaflets for treating various aortic valve diseases—including BAV—without replacement of the aortic valve. CMR can be used for the evaluation of aortic root and valve repair before and after CARVAR in patients with BAV.

Patient case

Pre- and post-surgical evaluation of BAV with CMR in a 65 year-old man. Double-oblique axial (Figures 6A, 6B) and coronal (Figure 6C) FIESTA Cine CMR images before surgery clearly demonstrate BAV with severe aortic stenosis and normal appearance of ascending thoracic aorta. Double-oblique axial (Figures 6D, 6E) and coronal (Figure 6F) FIESTA Cine CMR images after surgery clearly demonstrate tricuspidalized aortic valve with normal appearance of opening and closing.

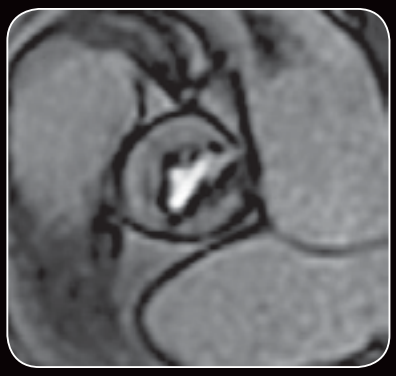

Figure 6A.

Figure 6D.

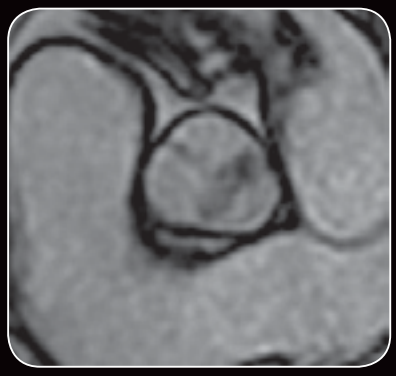

Figure 6B.

Figure 6E.

Figure 6C.

Figure 6F.

Figure 6. Pre-surgery with severe aortic stenosis (left column, A, B, C): Post-surgery with tricuspidalized aortic valve (right column, D, E, F).

Conclusion

CMR allows the accurate morphological assessment of BAV with related valvular complications, and the measurement of ascending aorta diameter, as well as evaluation of the related congenital cardiovascular malformations in patients scheduled for elective aortic valve surgery.

Sung Min Ko, MD, PhD, *is an Associate Professor in the Division of Cardiothoracic Imaging, Department of Radiology, at Konkuk University School of Medicine and Konkuk University Hospital. He received his medical degree from Yonsei Wonju College of Medicine and his post-doctoral degree from Chungnam University. Dr. Ko has been honored with several "Certificate of Merit" awards from various medical societies and currently serves as Scientific Secretary of the Korean Society of Cardiovascular Imaging. He is interested in valvular heart and coronary artery disease using CT and MRI. At RSNA 2011, Dr. Ko will present two oral and one poster presentations.*

Konkuk University Hospital *is an 870-bed establishment occupying a total space of 83,000 square meters, with 13 floors above the ground and 4 floors underground. In the inpatient department, there are 870 beds, including 92 beds of intensive care unit. In outpatient department, there are 31 units with 4 major specialized centers. The hospital, originally established in May, 1931, moved to a new facility in August, 2005.*

DOING MORE WITH WIDE BORE

How one facility increased image quality and patient volume by replacing two MR systems with one

Insight...

Since its launch in Summer 2009, GE has sold 150 Optima* MR450w systems.

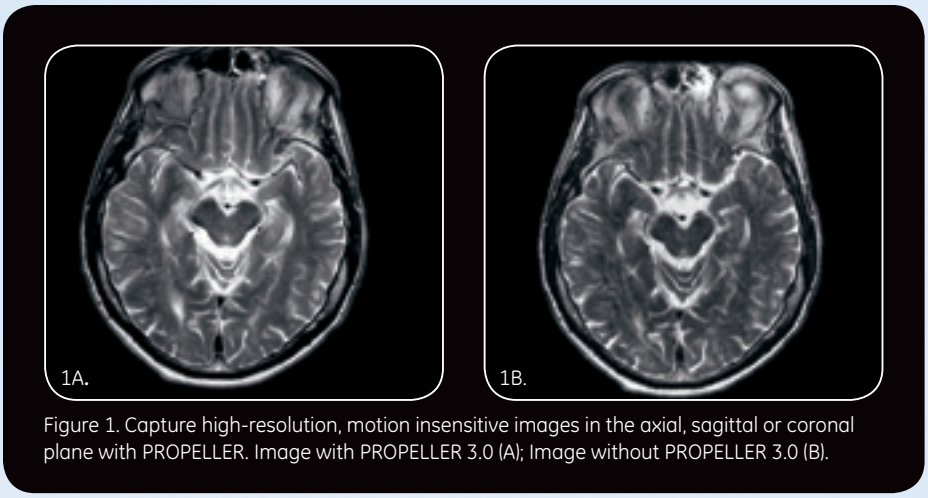

Figure 1. Capture high-resolution, motion insensitive images in the axial, sagittal or coronal plane with PROPELLER. Image with PROPELLER 3.0 (A); Image without PROPELLER 3.0 (B).

In an era of global economic recession and fiscal constraint, many healthcare providers are postponing new technology investments. In the US, uncertainty over healthcare reform and a changing healthcare landscape have further stymied new product purchases for many physician practices and health systems. Yet, for some healthcare leaders, these times of economic uncertainty present an opportunity for growth.

Just ask Del Creps, CEO of Envision Radiology, a national company, headquartered in Colorado Springs, Colo. Envision will be opening four new imaging centers in 2012 and at many existing centers, imaging volumes continue to increase. At some facilities, there is double-digit growth.

"We believe there are three critical success factors: spectacular service, unmistakable quality and execution. Our success is built on our staff and radiologists and how we differentiate our services."

For nearly 12 years, the company's vision has been to revolutionize how diagnostic imaging is delivered to the community. "We build relationships with the referring physicians and view our practice as an extension of theirs. This is a service industry, and that's what sets us apart from our competitors."

At Envision, patient wait times—currently averaging less than five minutes—are calculated and reviewed regularly; results are consistently delivered in less than three hours; and, high-quality imaging and patient comfort are the tenets of their success. It is the patient experience that Creps stresses as most important to the clinicians and staff.

So when Colorado Springs Imaging (CSI), one of Envision's 15 existing imaging centers, was having throughput issues with an older 1.5T traditional MR and 0.3T open MR, Creps worked with the center to evaluate the MR department and determine the best next steps to ensure the delivery of comfortable and high-quality patient care.

"We typically upgrade or replace our equipment every six to seven years—we believe you lead with quality systems," Creps explains. "With reimbursements declining, sites are buying used equipment or running their systems

> "We are scanning 10 more patients each day with the Optima MR450w than we did with two MR systems."
>
> *Del Creps, CEO of Envision Radiology*

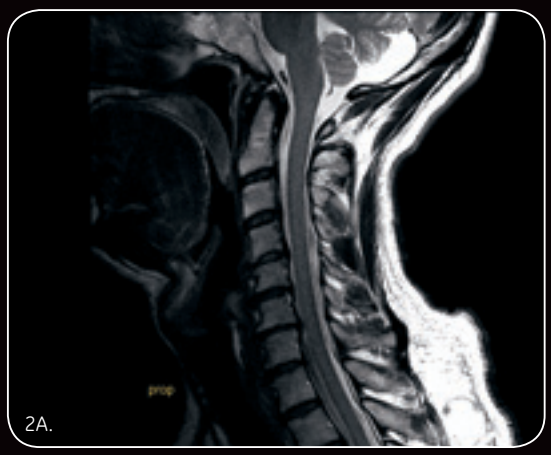

Figure 2. C-spine study with PROPELLER 3.0 (A); C-Spine study without PROPELLER (B).

longer, but they are missing out on great new software and hardware that increase quality and help the radiologists be even more accurate, confident, and successful. In the last 10 years, great advancements have occurred within MRI and some of the older equipment cannot keep pace."

A one-for-two deal

CSI planned to acquire a new high-field, wide-bore system to replace both magnets. The site had already established a leadership position in the community for scanning obese and claustrophobic patients. However, image quality was a concern due to the inherent lower resolution in low-field open systems.

"The key tipping point was when CSI's managers said they believed they could schedule 30 to 32 MR scans each day, but couldn't perform that output on the existing systems," Creps adds. In addition to the open magnet, CSI also had an older high-field system.

So Envision turned to GE Healthcare, an important collaborator for the imaging provider. Creps notes that GE's focus on the patient experience in the design of their new systems is a key differentiator that also fulfills his company's vision. "Plus, their service is really top in the industry, and the way GE executes it brings added value to their customers. It is important for us that GE is an extension of our service."

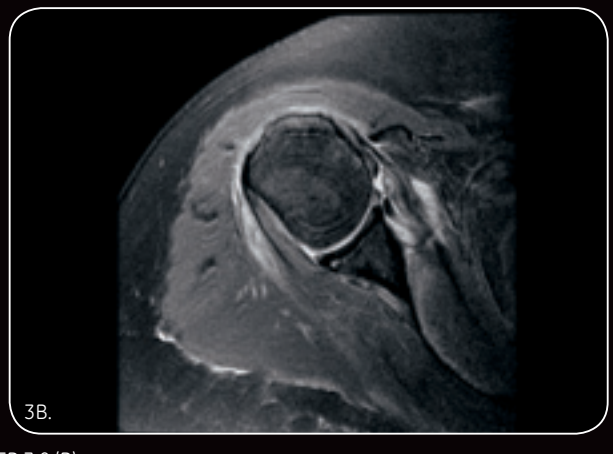

Figure 3. MRI of the shoulder: with PROPELLER 3.0 (A); without PROPELLER 3.0 (B).

Bob Zupan, RT (R)(MR)(CT)
is the Lead Tech at Colorado Springs Imaging (CSI).

With the Optima MR450w, Envision and CSI got both—high-quality imaging in a system that met both market and patient needs. With a 70 cm bore and advanced applications across a breadth of exams, the Optima MR450w replaced both magnets and met CSI's MR imaging needs.

Then, something happened that Creps and Bob Zupan, RT(R), lead MR tech at CSI, attribute directly to the new scanner: MR volume increased.

Quality + speed = growth

"We are scanning 10 more patients each day with the Optima MR450w than we did with two MR systems," says Zupan. "And, with the increase in SNR, the image quality has improved immensely; the new gradients make a big difference. With the 450w, we have the complete package."

More referrals are coming to CSI because of the new machine, Zupan notes, and it can handle almost any patient case and clinical indication. Plus, CSI can add additional patients to the MR schedule without increasing the hours of operation due to the system's speed and ease-of-use.

Most scans are completed in 30 minutes, some in under 15 minutes. This is a dramatic decrease from the 45 minutes to one hour scans that CSI ran with the older MR systems. Maximizing protocols and image quality gains are a main contributor to the shortening exam times, Zupan adds. The system is intuitive and easy to use—everything a technologist needs to program the scan is accessible from one screen page. And, the detachable table facilitates patient positioning, especially with patients who have limited mobility. "The detachable table is worth its weight in gold," Zupan says.

New coils also impact the technologist's efficiency. They are easy to work with and provide flexibility, yet what Zupan likes most is that he can plug in more than one coil at a time. "There are days when we change the patient and not the coil."

The most influential differentiator, impacting both quality and speed, are the new sequences. Zupan loves PROPELLER 3.0, and uses it as part of routine protocols. "Using PROPELLER 3.0, we basically get a 'guaranteed' scan. We aren't repeating studies, either, with this protocol."

Another sequence he uses frequently is IDEAL. He finds it is an excellent sequence for body imaging, particularly in scans with different tissue densities and sizes, and it also helps reduce artifact near metal or other distortions. "Our doctors love FatSat, so we consistently run IDEAL."

Zupan sees an opportunity to further grow the neuro imaging volumes with DTI and SWAN. "Once we start circulating these images to our referring neurologists and neurosurgeons, I expect we'll get more requests for these studies—and more referrals."

> "My experience with GE is we can run the MR system six to seven years and then upgrade it very economically to extend its useful scanning life another three to four years."

Del Creps, CEO of Envision Radiology

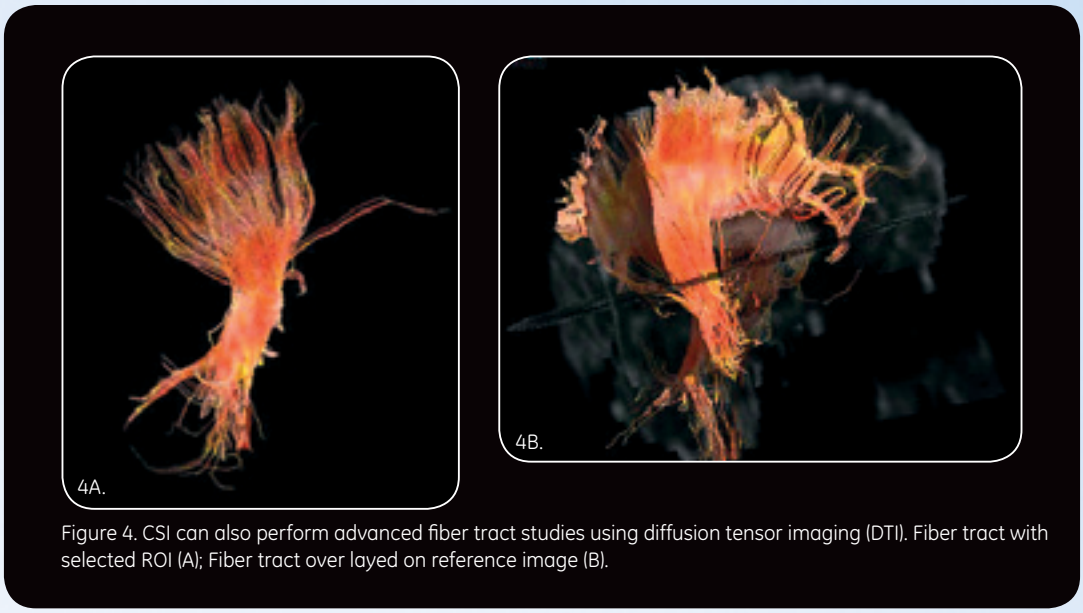

Figure 4. CSI can also perform advanced fiber tract studies using diffusion tensor imaging (DTI). Fiber tract with selected ROI (A); Fiber tract over layed on reference image (B).

The bottom line

Increasing volume while reducing overhead/expenses is a clear win for Envisions' bottom line. Creps cites service contract savings of over $110,000 per year since going from two MR systems to one at CSI. Plus, he believes these two factors along with the increase in image quality are crucial to remaining competitive.

In fact, Creps believes investing in advanced technology such as the Optima MR450w will help Envision further align with hospitals, healthcare systems, and Accountable Care Organizations (ACOs)—the latter being created under the Affordable Care Act of 2010 to help doctors, hospitals, and other healthcare providers better coordinate patient care and measure quality across settings.

Making the right investment—with the right equipment manufacturer is critical to success. Says Creps, "My experience with GE is we can run the MR system six to seven years and then upgrade it very economically to extend its useful scanning life another three to four years."

Creps' advice to other facilities: lead with technology and it will help increase operational excellence. Anticipate continued lower reimbursements and seek to gain back lower revenues with systems that help maximize staff efficiency and create new service offerings—just as the Optima MR450w has done for CSI and Envision.

"We've increased quality and patient throughput while our costs have gone down," Creps adds. That's a win all the way around—for the company, imaging center, patients, and referring physicians.

Del Creps *is the Chief Executive Officer of Envision Radiology, a national company that owns and manages outpatient medical imaging centers. He brings over twenty years of healthcare leadership experience to this thriving company. In the midst of a changing healthcare landscape, Mr. Creps dynamically leads Envision to growth and success. Educated at Ohio State University with emphases in Marketing and Accounting, Mr. Creps brings fiscal savvy and a drive for high level marketing and growth to Envision.*

Bob Zupan, RT (R)(MR)(CT), *is the Lead Tech at Colorado Springs Imaging (CSI). He earned his radiologic technologist degree from St Francis School of Radiologic Technology and completed additional MRI courses in Physics/Cross Sectional Anatomy. He previously served as Program Director of Memorial Hospital School of Radiologic Technology.*

Envision Radiology, LLC *owns and manages outpatient medical imaging centers throughout the country. Envision currently operates 13 centers located in Denver, Colorado Springs, Dallas/Fort Worth, Lafayette, and Tulsa. Envision consistently strives to provide the highest level of customer service through excellent quality scans, same day appointment scheduling, short and dependable report turn around times, compassionate care and education of our patients, and reliable superb services for our referring physicians. Within the next year, Envision expects to open five new imaging centers.*

POSITIVELY IMPACTING PATIENT OUTCOMES WITH iMRI SUITE

Something pretty amazing is happening in the middle of America's Dairyland. Neurosurgery tumor resection and deep brain stimulation (DBS) patients are receiving MR scans that help to guide the surgeons during their procedures.

The University of Wisconsin Hospital and Clinics, part of UW Health, recently completed the first installation in the US of a GE 1.5T wide bore MR Surgical Suite. Anchored by the Optima* MR450w, the suite has two connected rooms—an OR and MR room separated by double doors that enable movement from one sterile environment to another. This innovative set up allows clinicians and staff to image patients during tumor resections and Deep Brain Stimulation (DBS) procedures, while also preserving the ability of both rooms to serve surgical and imaging procedures independent of one another.

The OR table is aligned with the MR table facing the MR suite.

iMRI team discussing a neurosurgery case.

Technologists prep the MR suite after a neurosurgery intraoperative scan to prepare for additional outpatient MR exams.

> "In real time, iMRI can identify additional lesions and also, any intraoperative shift in the lesion location. It changes our intraoperative approach to surgery and may potentially provide a greater safety margin and higher degree of certainty that we've completely resectioned the tumor."
>
> *Dr. Robert J. Dempsey*

MR diagnosis in real-time

Within the context of surgical cases, the Optima MR450w from GE Healthcare is used for imaging tumor resections and performing DBS. According to Karl Vigen, PhD, MRI Physicist, Department of Radiology, the 70 cm bore on the Optima MR450w is ideal for the iMRI suite. "The wider bore is very important for flexibility in patient positioning," he says.

Additionally, Dr. Vigen is very impressed with the pulse sequences on the scanner. He notes it is crucial to have the capability to quickly acquire an entire volume of data with the appropriate image contrast for both conventional and intraoperative procedures.

"Our two most important sequences are T1 weighted volumetric imaging with BRAVO and T2 volumetric imaging with Cube," Dr. Vigen adds. "With ARC (parallel imaging) and the 6-channel Neuro Flex coil, we can achieve good coil positioning to obtain the acceleration factors needed (for speed) and generate high-quality images." The Flex coil, he says, is easy for the MR technologists to position for quality imaging.

For Howard Rowley, MD, Chief of Neuroradiology, having another tool that enables surgeons and radiologists to view tumor resections and DBS in real time—at a time where they can go back and modify the procedure—is a true game-changer. "We can determine while the patient is in surgery if the tumor has been completely resected," he says. "In cases of DBS, we can directly visualize the passage and position of electrodes when implanting devices. This is an exciting new tool that we use in patients with Parkinson's disease."

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A view of the Optima MR450w in the MR suite from the OR suite.

While it is too early to know the full impact on patient care, Dr. Rowley cites a recent study that found that 96% of patients who undergo glioma tumor section in conjunction with MR imaging actually have more complete resections. This is compared to 68% of patients who had more complete resection using traditional surgery without an MR scan.[1] Initial results suggest better long-term outcomes. "Removing more tumor translates to better patient survival, that's really the bottom line," he adds.

Both Dr. Vigen and Dr. Rowley are very pleased with the imaging performance of the Optima MR450w. "High image quality has been one of the most pleasant aspects of this entire process," says Dr. Rowley. It is superb when compared to the low-field systems he has seen in other operating room environments.

And, there is the full flexibility to run a range of 3D sequences such as Cube and BRAVO, while taking advantage of parallel imaging. PROPELLER 3.0-based diffusion-weighted imaging is another useful technique that helps combat susceptibility artifacts, Dr. Rowley adds.

additional lesions and also, any intraoperative shift in the lesion location. It changes our intraoperative approach to surgery and may potentially provide a greater safety margin and higher degree of certainty that we've completely resectioned the tumor."

> "Having this OR room independent from the MR room enables us to serve more patients and perform more cases than we otherwise would have been able to accommodate."
>
> *Denise Dillon, RN, BSN, CNOR*

Neurosurgery applications

In tumor resections, patient outcomes are dependent upon the success of removing the tumor during surgery. However, the completeness of the resection may not be evident at the time of surgery, explains Robert J. Dempsey, MD, Professor and Chairman of Neurological Surgery at UW Health. "In real time, iMRI can help identify

During the perioperative imaging, a neuroradiologist—such as Dr. Rowley—is in the MR control room for real-time diagnosis of the MR images. This can help avoid potential complications and the need to take the patient back to surgery.

> "We can accommodate more types of patients and we have more flexibility with positioning surgical patients in the wider bore."
>
> *Dr. Howard Rowley*

John S. Kuo, MD, PhD, Assistant Professor and Director, Comprehensive Brain Tumor Program at UW Health explains that, "The pituitary region is a small yet important area deep within the head and is difficult to image. High-field MR is one of the safest, most effective imaging techniques for this area."

Prior to installation of the iMRI system, patients had to wait for a follow-up MR scan to ensure maximal resection. Now, Dr. Kuo has immediate visualization and sometimes even where he cannot visualize portions of the tumor using endoscopy, he knows that iMRI will provide a timely surgical roadmap. As importantly, he can provide patients and families immediate feedback on the surgery success. "Instead of 'I think the maximal safe resection was done', I can immediately show them what was accomplished."

Dr. Kuo foresees many additional uses for real-time, perioperative MR imaging in tumor surgeries. "For many complex cases, such as brain tumors near important areas of brain function, a patient will benefit from the immediate feedback of an MR scan." He anticipates the ability to conduct more complex surgeries in a safer manner, and believes extending use of the suite to other neurosurgery applications will contribute to better care and more comprehensive research.

In addition to pituitary tumors, UW Health is using iMRI for DBS on Parkinson's patients. "Perhaps as few as 20% of patients with Parkinson's disease who may benefit from DBS undergo the procedure and concerns with awake surgery have been cited as a significant factor in the decision for some patients to consent to DBS," says Karl A. Sillay, MD, Assistant Professor of Neurological Surgery and Director of Adult Functional and Stereotactic Neurological Surgery at UW Health. Unfortunately, many patients are reluctant to undergo this procedure that can help to treat the symptoms of Parkinson's disease because they must be awake during the entire procedure, which often takes up to six hours.

Between April and September 2011, Dr. Sillay performed DBS on four patients—the first had waited for the opportunity to have the surgery while asleep under general anesthesia. "There is a segment of the population who has anxiety and fear of being awake during the surgery," he explains. If using iMRI becomes a standard of care, Dr. Sillay adds, the hospital has removed a significant barrier to patients consenting to a procedure that may help them.

There are additional benefits to performing DBS in the iMRI suite. For example, the patient does not have to be off medication as they do before and during the awake surgery. According to Dr. Sillay, it is easier to identify brain signals when the patient is off Parkinson's medication; yet many patients don't want to do this either. Also, certain steps in the treatment are eliminated and the workflow is significantly streamlined: There is no need to perform pre-op CT scans with the stereotactic frame in place and an MR scan for surgical planning.

"We can perform the high-resolution imaging for electrode placement during the procedure," Dr. Sillay says. "The reality is that the iMRI DBS surgery will sell itself to the patient who would otherwise elect to avoid awake brain surgery."

Two departments share one vision

"One of the key requirements in setting up the suite was that the MR room had the diagnostic capability and capacity to also image inpatients and outpatients," says Matt Henry, MBA, Radiology Manager—MRI, CT, & Research at UW Health. Room utilization is currently on par with the other four MR scanners at the hospital.

"From a financial standpoint, there are many imaging benefits with this particular magnet and we have scanned more patients because of it," he adds. Not only is it used for routine MR imaging, but the wide bore and

500-pound rated table accommodate larger-sized and claustrophobic patients. "Each week since we installed the system, there have been a handful of patients who weigh 400-plus pounds and without the wide bore scanner, we would not have been able to image them."

The same can be said for the OR suite. Denise Dillon, RN, BSN, CNOR, Surgical Services Supervisor, Neurosurgery, says, "The value of this additional OR room for our department is a huge plus, as our volumes are increasing at the moment. Having this OR room independent from the MR room enables us to serve more patients and perform more cases than we otherwise would have been able to accommodate."

It's all in the planning

Having two independent rooms was always part of the plan for UW Health. Throughout the planning stages, it was apparent that to achieve financial stability in addition to clinical success, each room had to maximize the volume of patients and procedures. Yet, planning for an intraoperative MR suite was the first challenge this team faced.

The journey began with meetings that included all stakeholders—radiology, nursing, neurosurgery, housekeeping, infection control, facilities management, and medical physics. Jordan Henry, RN, BSN, Neurosurgery Care Team Leader and a key facilitator throughout the planning stage also notes that the team conducted several site visits to similar OR/MR configurations.

Room planning was perhaps the most important consideration for the OR. Henry had to consider new obstacles,

such as losing one wall where the doors open to the MR suite for hanging and placing surgical equipment. He utilized a structural column in the middle of the OR as a place to hang surgical equipment and ensured that all electrical outlets are accessible to the surgical area to keep clear walkways for the surgeons and nurses. And, since the OR is in radiology and not near the other surgical suites, a storage area had to be included in the planning.

"This suite is very different from what we're accustomed to in a typical OR," Henry says. It also took planning to ensure that images from the MR scanner and PACS could be delivered into the OR suite in near real time or on an as-needed basis to help guide the neurosurgeons during the procedure.

"Another huge challenge was getting all the equipment to work together in a useable workflow that we could sustain," Henry adds. "The other aspect, operating in a magnetic field, was different from anything we'd ever experienced."

Key concerns were patient and staff safety, in particular ensuring that no ferrous materials enter the MR room during patient transport, and that the MR suite is sterile when used in conjunction with the OR. Henry and Dillon, along with the MR team, set up protocols with safety checks for patient and staff movement into the MR room from the OR. Stainless steel surgical tools were replaced with titanium tools and the typical fixed base OR table was replaced with a moveable base table.

There is also redundancy in the safety sweeps performed by the surgeon, surgical technologist, nurse, and MR technologist. In fact, the protocol stipulates that OR staff be MR compatible even when entering the OR room, notes Tammy Heydle, RT(MR), Senior MRI Technologist. "We adapted MR safety to the surgical environment with non-ferrous OR equipment, such as MR-safe monitoring equipment, that can move from the OR to the MR without disconnecting from the patient," she says. Also, a handheld magnet is swept over the OR table prior to patient transport.

> "Once the surgeon needs the MR, we bring the patient over and are able to determine if the tumor was entirely removed. After they take the patient back into the OR suite, we open the MR back up to outpatients until it is needed again by the surgeon."
>
> *Tom McKinlay, RT (MR)*

Just as the OR room had to adopt MR safety policies, so too did MR workflow and policies change to accommodate patient surgeries. "The MR room had to meet OR requirements, including air handling and the ability to clean the room with solid surfaces," says Dr. Vigen.

Tom McKinlay, RT (MR), Senior MRI Technologist, adds that the new MR workflow is designed to handle outpatient imaging at the same time as a tumor resection. "Once the surgeon needs the MR, we bring the patient over and are able to determine if the tumor was entirely removed. After they take the patient back into the OR suite, we open the MR back up to outpatients until it is needed again by the surgeon."

For McKinlay, the most rewarding aspect of his job in the iMRI suite is seeing how the patient benefits from this collaboration. "Not only are we resecting a tumor in one suite, but we are transporting the patient to the MR scanner to determine if the tumor was completely resected or if there is some left. That can only benefit the patient."

Acknowledgement:

The editor sincerely acknowledges the direction and input of Jeff Dalton, MR Advanced Applications Specialist, at GE Healthcare.

Collaboration breeds success

Across all team members—surgeons, radiologists, nurses, technologists, and administrators—one theme continued to surface: the collaboration of different UW Health departments and team members with GE Healthcare. In their opinion, not only is the Optima MR450w an excellent system for an iMRI suite (due to its 70 cm bore and ability of the MR table to move out of the bore for greater access to the patient), GE Healthcare is the ideal collaborator for venturing into relatively unknown territory.

In fact, with the successful implementation of the DBS and tumor resection neurosurgical procedures in the iMRI, UW Health is planning to add other specialty surgeries to the suite in the near future.

"We spent years developing this concept for the iMRI suite," says Dr. Dempsey, "but I told the hospital 'not yet' until I had a chance to see this system. What we have with this system is remarkable ease of use, an extremely high-quality magnet, some of the best sequences available, and a solid implementation and service team to back it up."

Dr. Rowley agrees with Dr. Dempsey assessment of the system, adding, "We can accommodate more types of patients and we have more flexibility with positioning surgical patients in the wider bore."

While there were challenges along the way, M. Henry credits GE Healthcare with finding solutions and resolving issues. "GE has been a strategic collaborator for us, including the research and development that we perform with the company. Yet, the ability to bring in a new wide bore MR system in the context of an interventional suite has really been unique for us—together we've created something new and exciting that, at the end of day, will positively impact patient outcomes. And that's really the most important aspect of this project."

Robert J. Dempsey, MD, Professor and Chairman of Neurological Surgery.

John S. Kuo, MD, PhD, Assistant Professor and Director, Comprehensive Brain Tumor Program.

Karl A. Sillay, MD, Assistant Professor of Neurological Surgery and Director of Adult Functional and Stereotactic Neurological Surgery.

Howard Rowley, MD, Professor of Radiology, Neurology and Neurosurgery and Chief of Neuroradiology.

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For more information: www.gesignapulse.com/signapulse/signapulseautumn2011#pg26.

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THE IMPACT OF A DEDICATED MSK MR SYSTEM IN THE DIAGNOSIS AND PROGNOSIS OF RHEUMATOID ARTHRITIS

By Professor Johan L. Bloem, MD, Chairman of the Radiology Department, Musculoskeletal Imaging Project Leader, and Wouter Stomp, MD, Researcher, Radiology Department, Leiden University Medical Center

Rheumatoid arthritis (RA) is a chronic inflammatory and autoimmune disorder that most often affects the small joints in hands and feet. RA primarily afflicts the synovial lining of the joints, causing a painful swelling that can eventually result in bone erosions and joint deformity. In addition to causing joint problems, RA is a systemic disease affecting multiple organ systems. It is two to three times more common in women than in men and generally occurs between the ages of 40 and 60.

Treatment options have expanded greatly in the past few decades and this disease is increasingly being treated in a very early stage in order to prevent further damage—rather than just treating symptoms. The key factor driving this move is the adoption of Tumor Necrosis Factor-alpha blockers, which have only become widely available in the last decade. One of the major problems with early treatment is

Professor Johan L. Bloem, MD
is a Professor, Director of the Residency Program, and Chairman of the Department of Radiology at Leiden University Medical Center.

identifying RA patients among the much larger group of early arthritis patients. MR is a very sensitive imaging technique that may play an important role in this identification process.

For many years, radiographs have been the standard imaging technique to follow RA progression. However, radiographs only show structural bone damage in the form of erosions, which are a relatively late event in the disease. MR, in addition to erosions, also directly shows synovitis (inflammation of the synovial membrane), tenosynovitis (inflammation of the fluid-filled cover called the synovium that surrounds a tendon), and subchondral changes. These inflammatory features are the main process in RA. As a further advantage, MR has been shown to be more sensitive to erosions than conventional radiographs.[1,2,3,4] The absence of erosions on MR has a high (80%) negative predictive value for developing RA.[5,6,7]

At the outpatient clinic of the rheumatology department at Leiden University Medical Center (Leiden, Netherlands), we asked patients from the early arthritis clinic to help determine the role of MR for non-specific early arthritis. Over a period of two years, patients with a possible diagnosis of RA will be examined with MR at several time intervals. Currently, the first patients are receiving their one-year follow-up examination.

As one of the first institutions in Europe to implement a dedicated 1.5T extremity MR from GE Healthcare, much effort has gone into optimizing the sequences and protocols for optimal image quality and imaging times. The images we obtain from the dedicated scanner have a very high quality, often surpassing that of full-body 1.5T systems for MSK applications.

One critical issue is the availability of scan capacity on our whole-body magnets. By using the dedicated extremity MR, patients can be scanned in the same week, and often on the same day as their initial visit.

Patient comfort is another important factor. Arthritis patients present with painful, swollen joints and are sometimes unable to maintain an awkward position required with imaging on a full-body system. With the dedicated extremity MR scanner, they can comfortably sit in a chair next to the scanner.

We are acquiring several images of the wrist and metacarpophalyngeal joints: coronal T1 and T2-weighted images, and coronal and axial fat-suppressed T1-weighted images. The images are then evaluated for the presence of bone erosions, bone marrow edema, synovitis, and tenosynovitis. Evaluation is standardized by using the OMERACT RAMRIS (Outcome Measures in Rheumatology Clinical Trials/ Rheumatoid Arthritis Magnetic Resonance Imaging Score), which was developed for MR in RA.

The clinical cases presented on the following pages demonstrate the clinical utility and excellent image quality of the high-field, dedicated extremity MR. We prefer to utilize this scanner for our patient evaluations based on scanner availability, patient comfort and high-quality imaging.

Wouter Stomp, MD
is a researcher in the radiology department at Leiden University Medical Center.

Figure 1. X-ray demonstrates minimal erosive changes of the first carpometacarpal joint and scaphotrapezial joint.

Figure 2. MR findings for early-stage RA.

Figure 2A. Wrist coronal T1

Figure 2B. Wrist coronal T1 fat-suppressed

Figure 2C. MCP coronal T1

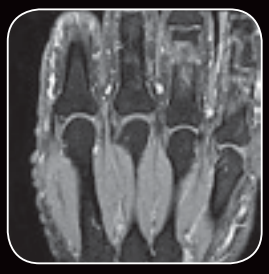


Figure 2D. MCP coronal T1 fat-suppressed

Figure 2E. MTP coronal T2-weighted MR

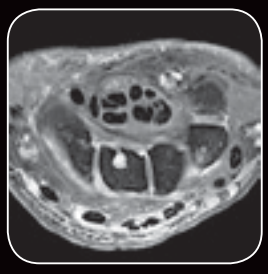


Figure 2F. Wrist axial T1 fat-suppressed

Case 1

Patient history

Early stage of pathology: Patient suffers from painful feet, right shoulder, and proximal interphalangeal joints (PIP) 4; treated with Arthrotec, Celebrex. Physical exam demonstrated swelling and pain PIP 4. Differential diagnosis of RA, reactive arthritis, and undifferentiated arthritis.

Prior X-ray demonstrates minimal erosive changes of the first carpometacarpal joint and scaphotrapezial joint (Figure 1).

MR findings

Coronal T1-weighted (Figure 2A), and coronal (Figure 2B) and axial (Figure 2F) T1-weighted, fat-suppressed, MR images of the wrist show multiple erosions in the carpal bones, including a large erosion in the capitate bone. MR of the metacarpal phalangeal joints (MCP) is unremarkable (Figure 2C, Figure 2D).

Coronal T2-weighted MR (Figure 2E) of the forefoot shows bone marrow edema proximal and distal of the first metatarsal phalangeal joint (MTP).

Figure 3. MR findings for synovitis and bone marrow edema.

Figure 3A. Wrist coronal T1 fat-suppressed

Figure 3B. Wrist axial T1 fat-suppressed

Figure 3C. Foot coronal T1

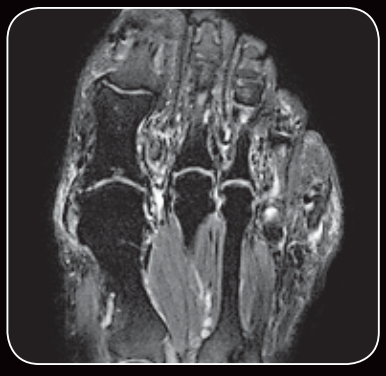


Figure 3D. Foot coronal T2 fat-suppressed

Figure 3E. MCP coronal T2-weighted MR

Figure 3F. MCP coronal T1 fat-suppressed

Case 2

Patient history

Synovitis and bone marrow edema; seronegative polyarthritis; possible RA; differential diagnosis of gout or polymyalgia rheumatic. Patient treated with Arcoxia, started on Methotrexate. Physical exam shows pain and swelling of the wrist, MCP 1,2,3 and PIP 3,5. X-ray demonstrates normal hands without erosions.

MR findings

Coronal (Figure 3A) and axial (Figure 3B) fat-suppressed, T1-weighted images show synovitis of the radio-ulnar, radiocarpal, intercarpal, and carpo-metacarpal joints with tenosynovitis of the flexor tendons. Several small erosions are observed in the carpal bones. The MCP joints (Figure 3E, Figure 3F) appear normal.

Coronal T1 (Figure 3C) and T2-weighted (Figure 3D) MR images of the forefoot show an erosion in the third proximal phalanx with no other abnormalities.

Figure 4. MR findings for late-stage RA.

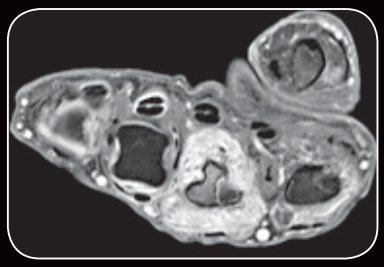
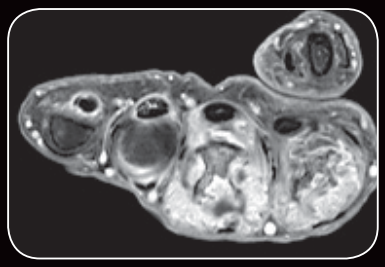


Figure 4A.



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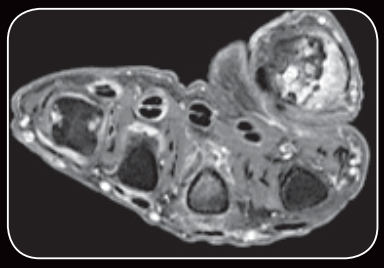

Figure 4C.

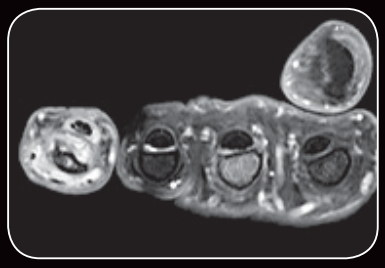

Figure 4D.

Case 3

Patient history

Late stage RA, seropositive erosive RA. Patient complained of symptoms for 15 years; X-ray demonstrates extensive destruction of the MCP joints. Patient treated with Methotrexate since September 2010; physical exam shows swelling of MCP 2.

MR findings

Coronal (Figure 4E–H) and axial (Figures 4A–D, Figure 4F) T1-weighted, fat-suppressed MR shows extensive synovitis with joint destruction in the wrist, including the first, second, third, and fifth MCP, and fifth PIP joint.

Figure 4. MR findings for late-stage RA.

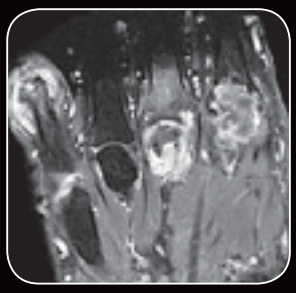

Figure 4E.

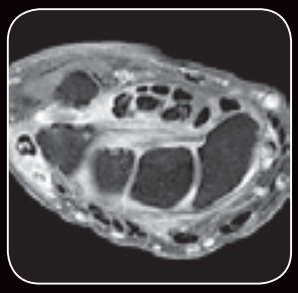

Figure 4F.

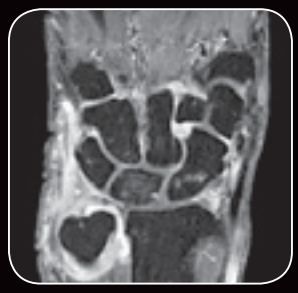

Figure 4G.

Figure 4H.

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Wouter Stomp, MD, *is a researcher in the radiology department at Leiden University Medical Center, pursuing his PhD on the use of MR for the early detection of rheumatoid arthritis. Dr. Stomp earned his medical degree at Rijksuniversiteit Groningen and completed an internship and extracurricular internship in radiology at Deventer Hospital. He also completed a pediatric surgery internship at Wilhelmina Children's Hospital.*

The Leiden University Medical Center (LUMC) *is one of eight university medical centers in the Netherlands and employs 7,000 people. Patient care is focused on highly specialized and top-level clinical care, including organ transplants, cardiovascular interventions, and all types of bone marrow transplants. The research conducted in the LUMC is both fundamental and patient- and care-oriented. A considerable portion of the research focuses on the translation from fundamental research to use in patient care. The Department of Radiology has a longstanding tradition in scientific research at the interface of technological innovations and healthcare. The aim is to develop imaging technologies that can be used in patients for diagnostic purposes or as instruments to increase the understanding of diseases.*

HOSPITALS UNCOVER ECONOMIC VALUE IN MR UPGRADES

> "The HDxt Optima Edition 16.0 has a tremendous impact on quality and clinical efficiency."
>
> *Dr. Russell N. Low*

Following are the experiences of several institutions that are realizing shorter exam times, fewer repeat scans, and, as a result, high clinical efficiency and patient throughput.

LAVA Flex, eDWI, and SSFSE

Sharp & Children's MRI (San Diego, Calif.) tracks patient volume, which has shown consistent growth. According to Russell N. Low, MD, Medical Director, "We can either add capacity—more scanners—or shorten the scan time to accommodate more patients." While increasing capacity has an economic benefit for the facility, Dr. Low has another, more patient-centered desire. "The faster we can scan patients while obtaining a high-quality study, the more MR exams we can perform on each scanner per day. Patients also really like the faster exam times and are more likely to cooperate fully. For our pediatric patients, we can avoid general anesthesia in some cases by scanning faster and using video goggles to show them cartoons or movies during the study. For the child, this eliminates the recovery time after the MR exam and the potential risk of an adverse reaction when using general

Acknowledgement

The editor sincerely acknowledges the direction and input of Katie McMillan, Clinical Development Manager, Neurology Applications, at GE Healthcare.

Today's worldwide economic uncertainly poses new financial constraints for hospitals, especially public-funded systems. Investing in new technology, with particular focus on software upgrades for currently-installed MR scanners, could reap economic benefits for the healthcare system—potentially enabling the site to generate a return-on-investment in a shorter time frame.

Russell N. Low, MD

Medical Director at Sharp and Children's MRI Center in San Diego and since 1991 has practiced with San Diego Imaging Medical Group.

anesthesia. Ultimately, everyone benefits. Faster body MR exams and greater efficiency is good for patients and for the MRI center."

"Since April 2011, we have been scanning with LAVA Flex, eDWI, SSFSE, and MR Touch with the GE Continuum* 22.0 release on our Discovery* MR450," he explains. With these new sequences Dr. Low and his team initiated several workflow optimizations, including:

- SSFSE Localizer with ARC: The higher resolution scan enables the elimination of the coronal SSFSE scan.
- eDWI: Multiple b values are acquired in one breath-hold instead of two, eliminating the second 40 second scan.
- LAVA Flex: Pre-contrast in-phase and out-of-phase and fat and water images eliminate the FGRE dual-echo scan.
- LAVA Flex: Dynamic post-contrast imaging.
- SSFSE replaced the conventional respiratory triggered scan. This fast scan is used due to SPECIAL FatSat and provided excellent image quality without respiratory artifact.

"After two months, we analyzed patient records to check total exam times," Dr. Low explains. "Combining LAVA Flex, eDWI, and SSFSE for a routine liver exam led to gains in efficiency compared to a conventional body exam." Scanning time was reduced by almost five minutes, with a decrease in total exam time to 15 minutes or less, including routinely performed MR elastography and T2 StarMap.

Specifically, eDWI enhancements with 22.0 include increased signal-to-noise ratios (SNR) and more robust fat suppression for improved workflow

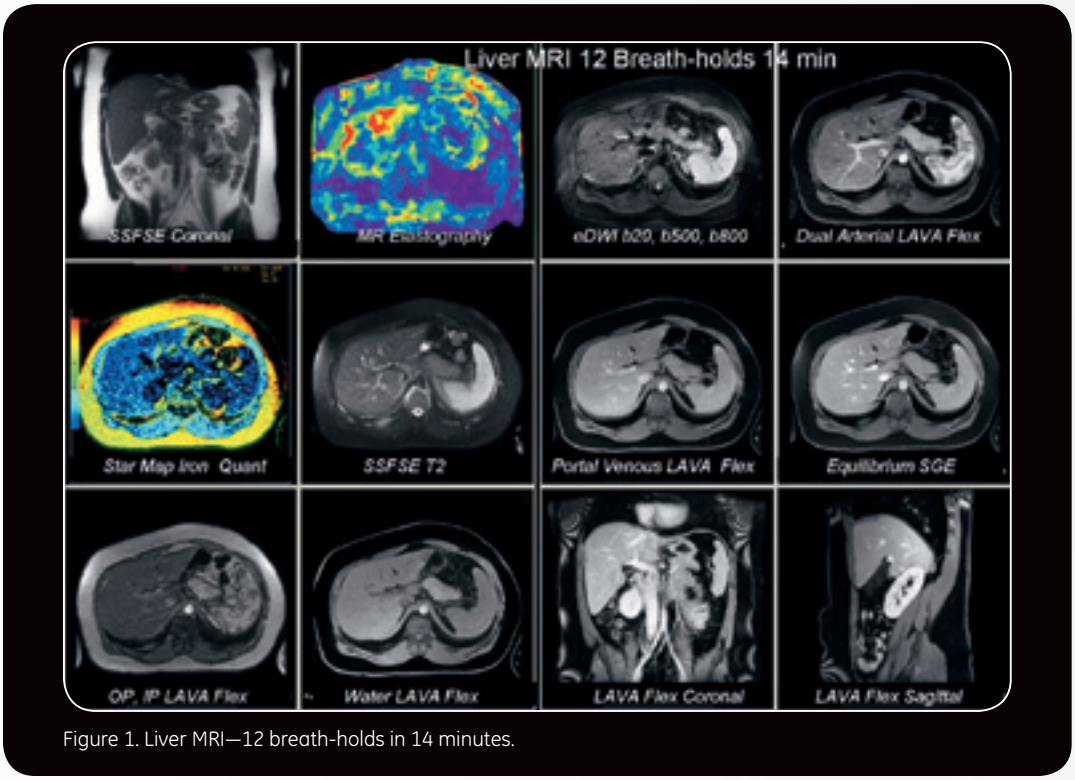


Figure 1. Liver MRI—12 breath-holds in 14 minutes.

and shorter scan times. LAVA Flex allows the acquisition of out-of-phase and in-phase echoes in the same TR, based on a volumetric FSPGR sequence. Using ARC does not require an external calibration scan, provides 3D kernel and combines hybrid-space technique with neighborhood calibration.

According to J.C. DePass, RT, "Different series can be linked together to match the scan coverage, shim volumes, and SAT bands to automate series prescription. Changes in one linked series will be automatically applied to the other linked series." Features such as Auto Save and Auto Scan* further streamline his daily workflow. DePass performs a fast manual prescan with LAVA Flex scans, thanks to the prescan insensitive nature of the application, and saving upwards of one minute per exam. And, when the number of scans and breath-holds are reduced, so too is the time spent prepping the patient, he adds.

Sharp & Children's also upgraded three Signa* HDx systems to the new HDxt Optima* Edition 16.0 release with impressive results. Dr. Low is performing a combined abdominal and pelvic body MR scan in 22 minutes or less. These exams once took two hours and, even today, may take 45 minutes to one hour. With the 16.0 upgrade, Sharp & Children's MRI conducts the 22-minute scans with the following protocol: a single shot FFSSE localizer; T1 LAVA Flex; fat-suppressed T2 SSFSE; eDWI (diffusion) in a breath-hold; sagittal T2 FRFSE of the pelvis; and then dynamic post-contrast LAVA Flex in multiple planes. "It's 17 breath-holds in 22 minutes," he adds.

Yet, the most important aspect, as far as Dr. Low is concerned, is the increase in image quality. "In particular, LAVA Flex creates sharper, more detailed, homogenous, fat suppressed images. Even if we didn't save exam time, I would still do the upgrade for the exceptional image quality. The HDxt Optima Edition 16.0 has a tremendous impact on quality and clinical efficiency."

While technology plays an important role in decreasing MR scan times at Sharp & Children's MRI, Dr. Low and DePass emphasize that by analyzing the entire exam process, additional time savings can be found. Good communication with the patient can enhance cooperation and reduce preparation time as well, DePass notes.

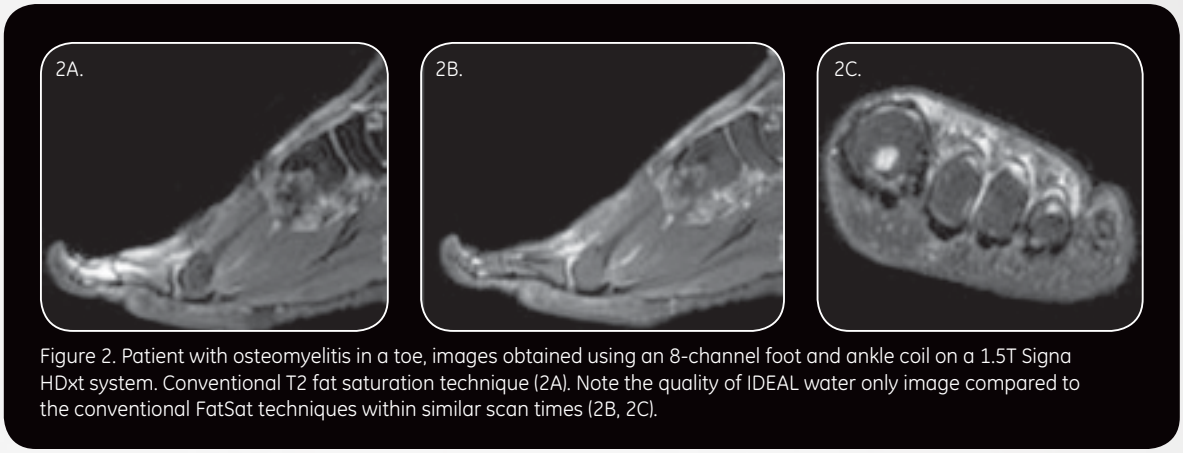


Figure 2. Patient with osteomyelitis in a toe, images obtained using an 8-channel foot and ankle coil on a 1.5T Signa HDxt system. Conventional T2 fat saturation technique (2A). Note the quality of IDEAL water only image compared to the conventional FatSat techniques within similar scan times (2B, 2C).

IDEAL

As a major diabetes center in the United Kingdom, St. Mary's Hospital performs an average of five foot exams each week. However, fat saturation can be difficult to obtain or of poor quality in the foot, notes Professor Wladyslaw Gedroyc, MBBS, MRCP, FRCP, Director of MRI.

Wladyslaw Gedroyc, MBBS, MRCP, FRCR
is Medical Director of MRI at St. Mary's Hospital (London) and Professor of Radiology at Imperial College (London).

"In the past, we would use STIR when FatSat failed. We have found that IDEAL helps to salvage certain diagnostic examinations, yet unlike STIR, is a conventional spin echo sequence and can be interpreted with reasonably thin slices," Professor Gedroyc says.

On the Signa HDxt 1.5 Optima edition MR at St. Mary's Hospital, IDEAL generates four contrasts from each acquisition—water only; fat only; in-phase; and out-of-phase. A review of IDEAL in foot imaging compared to T2 FatSat techniques found:

1. Many of these patients are elderly or in pain; IDEAL helps technologists focus on patient comfort rather than the foot position in relationship to the isocenter of the scanner.
2. Technologists note a reduction in rescans for foot exams, yielding increased confidence during scan sessions.
3. IDEAL, with proper parameters, can be performed with equivalent scan times to conventional FatSat techniques. Therefore, better quality can be achieved without increasing scan times.

The department conducted a retrospective review of 40 patient exams—20 using IDEAL, the other 20 using FSE FatSat—between May and July, 2011. When compared to FSE, IDEAL reduced scan time by one minute per exam. More impressively, IDEAL resulted in no repeat scans versus eight repeat scans with FSE.

"We found that over the course of one month, the reduction in scanning time and elimination of rescans with IDEAL results in approximately one hour savings," notes Professor Gedroyc. Even in small volume applications such as the foot, significant time savings are achieved, he adds. "IDEAL helps us obtain high-quality images on foot patients with greater confidence than conventional spin echo."

> "We found that over the course of one month, the reduction in scanning time and elimination of rescans with IDEAL results in approximately one hour savings."
>
> *Professor Wladyslaw Gedroyc*

IDEAL

Since 2010, Masaaki Naito, MD, has prescribed IDEAL for total spine exams at Iwata City General Hospital. He prefers IDEAL over FSE because it acquires three readouts at different echo times and generates phase maps between water and fat. This leads to mapping of true fat and water frequencies that generate robust images without fat-related artifacts.

Masaaki Naito, MD
is Chief of the Department of Radiology at Iwata City General Hospital.

"The fat/water separation provided by IDEAL is typically of such high quality that the sequence helps to avoid rescans," Dr. Naito explains. In the past, he continues, rescans were sometimes necessary with conventional FSE, which lead to additional time to prescribe that series (e.g., relocate shim volume), speak to the patient, and scan.

According to Masaki Terada, RT, the technologists also prefer IDEAL over FSE. "We have much more confidence in the image quality using IDEAL for C-spines compared to conventional FSE," he says.

A retrospective analysis of 18-months of scan data comparing FatSat to IDEAL demonstrated a six minute per exam time savings with IDEAL—a 20% reduction in scan time. The data also showed that, when using IDEAL, 0% rescans were observed.

"Our analysis showed we saved upward of 40 hours of scan time over those 18 months," explains Dr. Naito. "This translates to a capacity increase of four total spine exams per month in addition to improved image quality and patient experience. IDEAL helps us make the proper patient assessments and realize scan time reductions."

Terada also notes that patients are more comfortable because the exam time has shortened since the hospital began using IDEAL. As a result, IDEAL is now used routinely for all C-spine studies at Iwata City General Hospital.

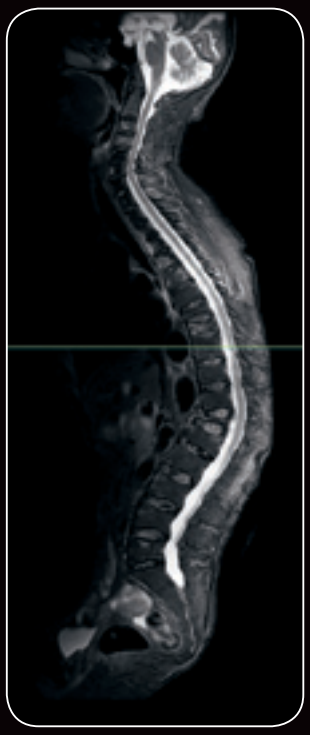


Figure 3. The IDEAL T2 water only images shows a compressed fracture at T12 with an excellent conspicuity. The fat/water separation provided by IDEAL is typically of such high quality that the sequence helps to avoid rescans.

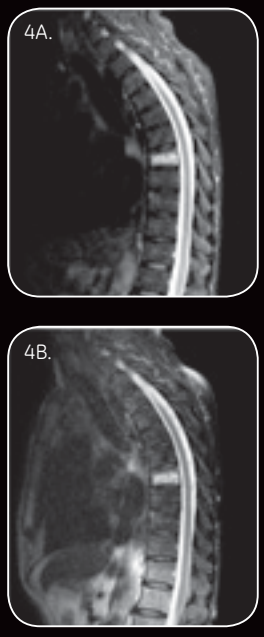


Figure 4. A different case with compressed fracture at thoracic spine (scanned at 1.5T with a CTL coil) demonstrates excellent fat/water separation with IDEAL. While the lesion is visible in both scans, note the quality of fat saturation at the edge of the large FOV on the IDEAL image (A) compared to the T2 FatSat (B).

> "Our analysis showed we saved upward of 40 hours of scan time over those 18 months."
>
> *Dr. Masaaki Naito*

PROPELLER 3.0

MR scanning of the shoulder can be particularly difficult to obtain high-resolution, diagnostic images often due to fat saturation failures or patient motion. Eric Pessis, MD, at Centre Cardiologique du Nord (CCN) began using PROPELLER 3.0 with the Discovery MR450 on shoulder studies and has found the sequence's advanced motion correction algorithm further reduces the effect of voluntary and physiologic motion. Over six-months, Dr. Pessis conducted 180 shoulder MR exams and retrospectively reviewed the clinical data to assess the scan time and the number of rescans performed.

Eric Pessis, MD

A radiologist at Centre Cardiologique du Nord (CCN) in Saint Denis, France since 2001, he specializes in MSK imaging.

"Based on the patients we analyzed, the number of scans corrupted by motion or fat saturation was 30% without PROPELLER 3.0," Dr. Pessis says. "With PROPELLER 3.0, we did not have any non-diagnostic exams and the scan is 18% shorter than the traditional FSE FatSat protocol."

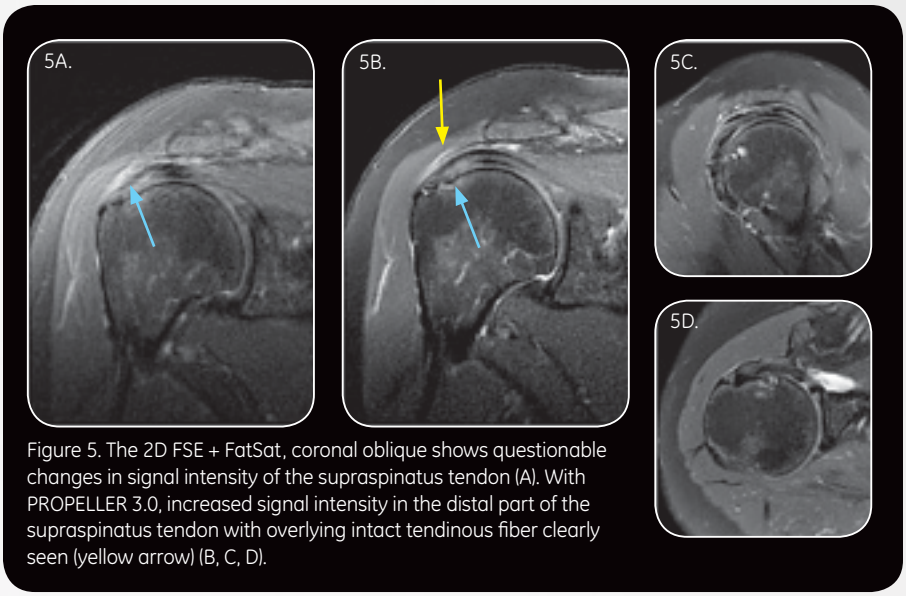


Figure 5. The 2D FSE + FatSat, coronal oblique shows questionable changes in signal intensity of the supraspinatus tendon (A). With PROPELLER 3.0, increased signal intensity in the distal part of the supraspinatus tendon with overlying intact tendinous fiber clearly seen (yellow arrow) (B, C, D).

The time saving is achieved in the PD/T2-weighted scans (2.4 minutes less with PROPELLER 3.0). Over the analyzed time period, CCN saved 10.4 hours, allowing the center to scan approximately 5 additional shoulder patients each month, or 31 additional MSK patients utilizing 20-minute time slots per exam.

"Besides the time savings, our diagnostic confidence significantly improved with PROPELLER 3.0 on all our shoulder exams, which is visible in the patient reports and much appreciated by our referring physicians."

Summary

Current economic pressures demand strong evidence of return on investment and can, in some instances, make justifying a new MR scanner difficult. There are strong opportunities to show reduction in scan time, increased image quality, and better patient satisfaction by considering application upgrades for currently-installed GE scanners.

Applications such as LAVA Flex, IDEAL, and eDWI are available with the HDxt Optima Edition upgrade for Signa scanners and the 22.0 release for Discovery and Optima systems. PROPELLER 3.0 is currently available only on 22.0.

Russell N. Low, MD, *is Medical Director at Sharp and Children's MRI Center in San Diego and since 1991 has practiced with San Diego Imaging Medical Group. He received his medical degree from the University of California, San Diego, with honors and participated in the NIH Research Training Program. Dr. Low interned at St. Mary's Hospital and Medical Center (San Francisco) and completed his residency in diagnostic radiology at the University of California, San Francisco and his fellowship in MRI/CT/Ultrasound at Stanford University Medical Center (Palo Alto, CA). He has authored over 60 articles and five book chapters, and is a frequent speaker at symposiums and conferences, including RSNA and ISMRM.*

Wladyslaw Gedroyc, MBBS, MRCP, FRCR, *radiologist, is Medical Director of MRI at St. Mary's Hospital (London) and Professor of Radiology at Imperial College (London). He has vast experience in vascular imaging, especially in renal artery diseases and renal transplant. Professor Gedroyc has published over 80 papers in peer reviewed journals related to vascular MRI, interventional focus ultrasound, and other MR-related topics.*

Masaaki Naito, MD, *is a radiologist with Iwata City General Hospital (Iwata, Shizuoka, Japan). Dr. Naito received his degree in medicine from Hamamatsu University School of Medicine. He has been Chief of the Department of Radiology at Iwata City General Hospital since 1997.*

Eric Pessis, MD, *has been a radiologist at Centre Cardiologique du Nord (CCN) in Saint Denis, France since 2001. He specializes in MSK imaging. Prior to joining CCN, Eric Pessis completed his internship and residency in radiology in various prominent public hospitals in the region of Paris, such as CHU de la Pitié Salpêtrière, CHU de Kremlin-Bicêtre and CHU Cochin from 1988 to 1994. He also served as Chief Physician Assistant at the MSK radiology department of CHU Cochin in Paris between 1995 and 1998.*

Insight...

READY View provides a new architecture for the visualization of MR data, including:

- Post-processing images in 3D or 4D
- Generating parametric maps in any orientation
- Fusing images
- Compatibility with all Volume Viewer tools and integrated registration

Dr. Catherine Oppenheim
is a Professor of Radiology at Paris Descartes University, Sainte-Anne Hospital.

NEURO IMAGING VISUALIZATION WITH READY VIEW

By Professor Catherine Oppenheim, MD, PhD,
Department of Neuroradiology, Centre Hospitalier Sainte-Anne

Analyzing functional and dynamic MR data provides important information for the clinical diagnosis of brain tumors and stroke. However, post-processing this data has historically been a time consuming process as functional data was analyzed one sequence at a time. New software from GE Healthcare now makes all the information from the sequences available in one view. This is particularly important in stroke cases, where we need to be quick and make timely decisions for optimal patient care. In the case of brain tumors, fusing MR data such as perfusion data, spectroscopy, diffusion tensor imaging, and fMRI can be extremely helpful in determining the diagnosis and prognosis and also in planning the best intervention route. Powerful software tools are also needed to create and fuse parametric maps.

READY View allows us to process all metabolic and functional MR neuro data even if the sequences were not acquired with identical geometry, such as 2D, 3D, or oblique slices. The software is compatible with integrated registration and all Volume Viewer tools, especially important when patients are scanned with more than one imaging modality or for a longitudinal imaging session.

Following are four clinical cases—two stroke and two brain tumor—that further illustrate the clinical utility of the new READY View post-processing software and how it can be used to help facilitate an accurate diagnosis.

Brain tumors
Case 1

A woman 33 weeks pregnant was admitted for generalized seizures. An MR‡‡ exam was done to determine if a tumor was present, and if it was, to determine when to do surgery. An analysis of T1 and FLAIR data indicated the presence of a large tumor.

READY View provided steps to simplify the review process for each study—ASL, Brain Spectroscopy, Choline Creatine Ratio, dynamic imaging, and CBF/FLAIR. The software application allowed the user to improve image quality by reducing noise or selecting other advanced parameters. It is also possible to compare the metabolic profiles in the healthy hemisphere of the brain to the portion with the tumor.

READY View provided a number of maps for comparing choline and creatine ratios. Review of the contrast perfusion further demonstrated no CBV increase. However, a hot spot on the ASL sequence required further analysis; the 2D perfusion and 3D post-contrast enhancement data were fused using READY View to determine the anomaly was simply a normal vessel.

Consistent findings between the ASL and the CBF maps obtained after perfusion weighted imaging, indicating low CBF and CBV values, high ADC, and moderate choline increase, supported diagnosis of a low grade glioma. Based on the READY View analysis of the MR exam, a follow-up imaging study was planned for the patient post-pregnancy.

When the woman returned to have the tumor scanned after delivery, READY View was used to compare images from the new and prior study. To do that you can compute and save CBV maps on READY View and then reload them with an integrated registration application. Before and after image comparison indicated the lesion was stable.

‡‡ MR scanning has not been established as safe for imaging fetuses or infants. Carefully compare the benefits of MR versus alternative procedures before scanning to control risk to the patient. A physician needs to decide to scan pregnant or infant patients.

READY View helps to support accurate and confident diagnoses with fast, easy, and quantified analysis of MR images from multiple data sets, such as:

- Simple, real-time parametric image calculation and/or processing;
- Real-time multi-parametric analysis;
- "Drag and drop" image fusion;
- MR to MR image registration; and
- Complete region of interest toolbox with auto-contour, propagation, conversion and ROI mirroring.

READY View eliminates steps and helps increase productivity, including:

- Auto-processing as simple as 1, 2, 3;
- One-touch and guided workflows;
- One-click access to tools, images, parameters, and image modes from anywhere in the application; and
- Easy and reliable save and restore functionality.

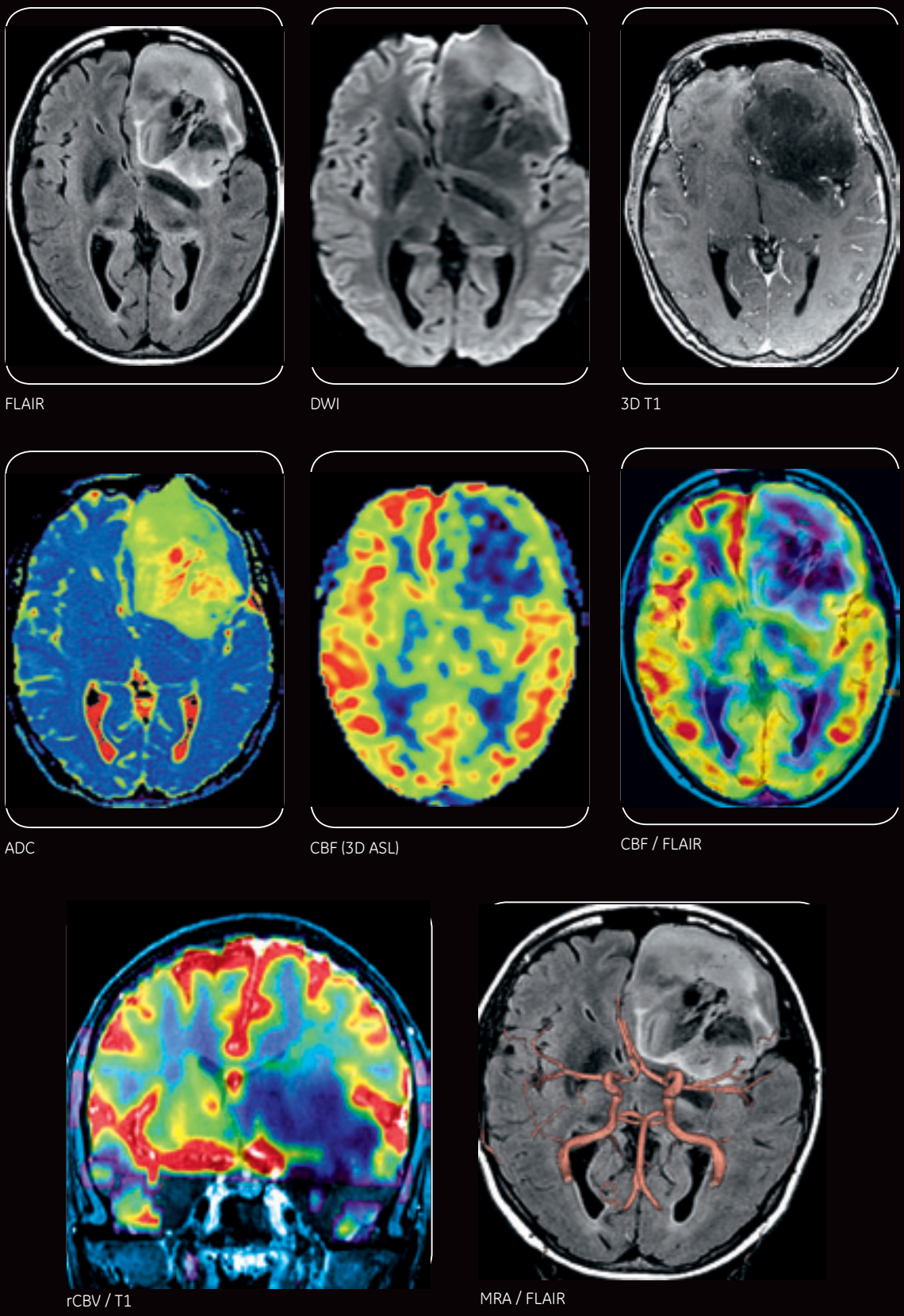
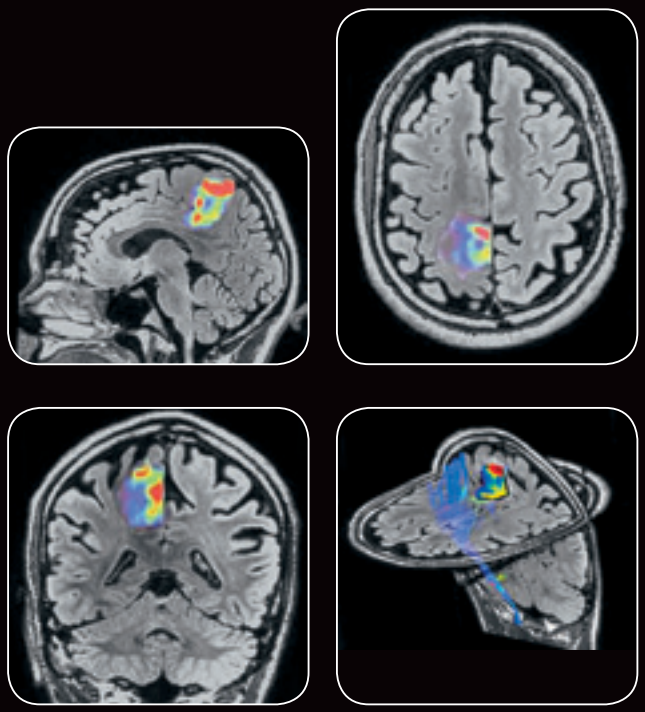


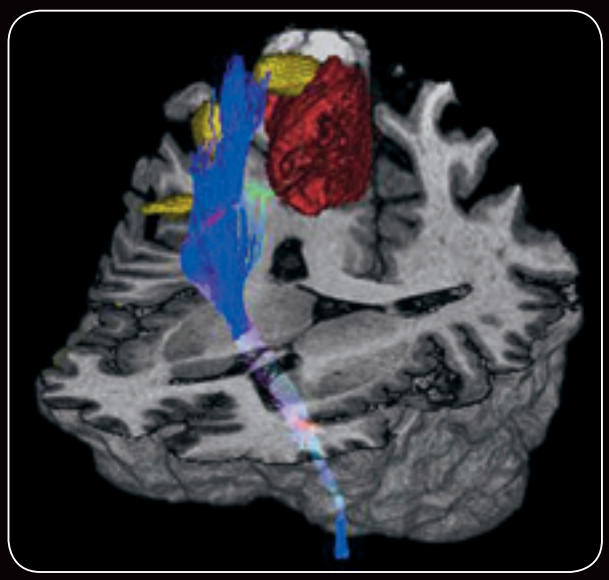
Figure 1. Consistent findings between the ASL and the CBF maps obtained after perfusion weighted imaging support diagnosis of a low grade glioma.

Case 2

A young man with a left limb mobility issue was referred for pre-surgical workup. The surgeon specifically asked for information regarding the position of the tumor in relation to the motor and corticospinal tract. An MR study indicated a brain tumor that did not show contrast enhancement. Using READY View, an increase in CBV and a choline peak was associated with the area. Following the multi-parametric protocol, step-by-step workflow on READY View and analysis of the DTI images helped determine the precise location of the spinal tract in relation to the tumor and the location of the motor cortex. When 3D renderings of fiber tracts are generated from READY View, the software merges this information with other anatomical or functional scans showing the areas of motor brain function in relation to the tumor volume. Results showed the corticospinal tract in relation to the tumor and indicated that the surgeon could likely remove the tumor without damaging the corticospinal tract but that care should be taken with respect to the motor functions.



DTI/CBV/FLAIR



Fusion with BRAIN WAVE results

Figure 2. Using READY View, the surgeons can determine the precise location of the spinal tract in relation to the tumor and the location of the motor cortex.

Tumor

Cortico-spinal tract

fMRI : primary motor cortex

Case 3

A 50 year-old man woke up in the morning with a right hemiparesia and aphasia. Using an MR stroke protocol, patient images were acquired in less than 10 minutes to determine if rt-PA should be administered. Sequences included T1, Diffusion, 3D Time of Flight, axial FLAIR, and a time-course series. Using READY View, all images were viewed simultaneously.

A suspected clot was noted on the T2* image. Using the Volume Viewer tools, the region of interest was segmented and, with one click, the volume of the ischemic lesion on DWI was assessed and occlusion of an artery was identified. Regarding the question of whether to administer rt-PA, multiple views in READY View enabled the user to determine the nature of the stroke (i.e., ischemic), that there were no FLAIR signal changes, and there was a large mismatch between perfusion and diffusion.

Patient was administered rt-PA and subsequent images demonstrated the clot was dissolved. Patient was discharged free of symptoms three days later.

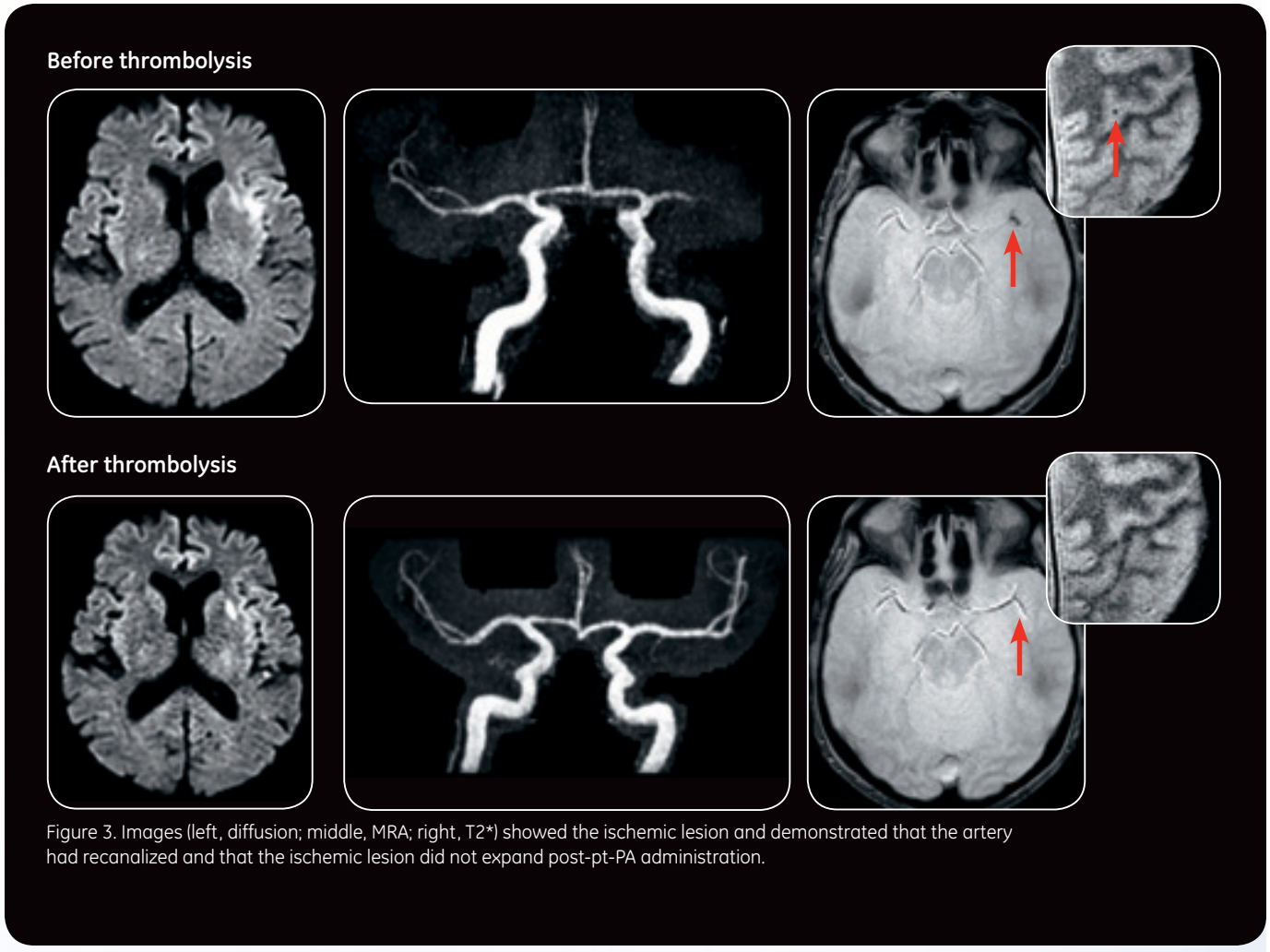
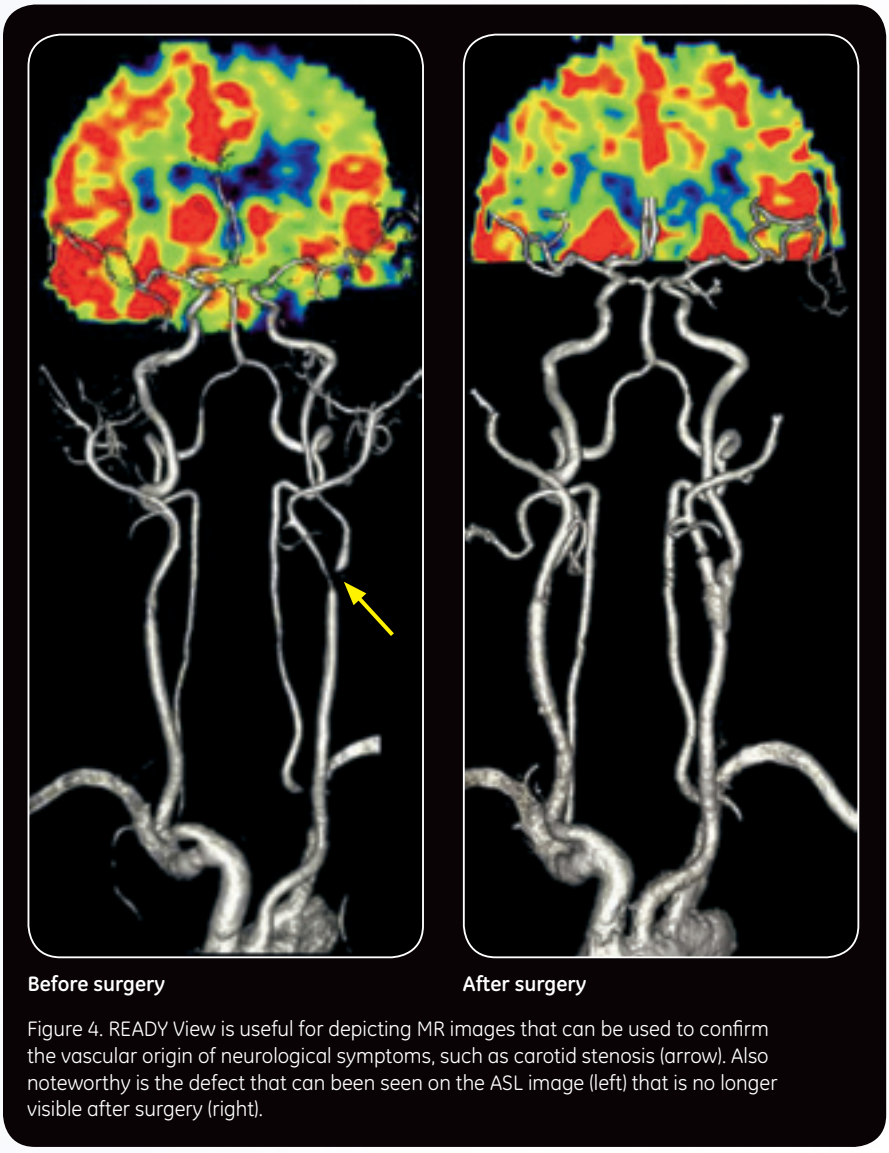


Figure 3. Images (left, diffusion; middle, MRA; right, T2*) showed the ischemic lesion and demonstrated that the artery had recanalized and that the ischemic lesion did not expand post-pt-PA administration.

Case 4

A 73 year-old man with a language deficit for three hours received an MR exam to determine if he had a TIA (transient ischemic attack) or another disorder. After the technologist post-processed the images, READY View allowed the clinician to reload the images, change the threshold, or re-compute the data for new post-processed images if necessary. Another advantage of READY View is the ability to easily fuse functional maps to MR angiography for a more comprehensive picture of the patient's status.



Before surgery **After surgery**

Figure 4. READY View is useful for depicting MR images that can be used to confirm the vascular origin of neurological symptoms, such as carotid stenosis (arrow). Also noteworthy is the defect that can been seen on the ASL image (left) that is no longer visible after surgery (right).

Conclusion

READY View provides a new architecture for the visualization of MR data, including post-processing images in 3D or 4D, generating parametric maps in any orientation, fusing images, and compatibility with Volume Viewer tools and integrated registration.

Review steps on the left side of the screen are simple to use and provide guidance for image analysis. In our clinical use, READY View helps us arrive at fast decisions regarding stroke treatment as all the information is available in one view. S

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Catherine Oppenheim, MD, PhD, *is a Professor of Radiology at Paris Descartes University, Sainte-Anne Hospital. She is a reviewer for several international journals and a member of the French Society of Neuroradiology, French Society of Radiology, European Society of Neuroradiology, and European Society of Radiology. In addition to her teaching responsibilities, Professor Oppenheim has upward of 140 publications on the imaging of stroke, epilepsy, brain tumors, and mental disorders.*

The imaging department of the ***Sainte-Anne Hospital center,*** *directed by J.F. Meder, investigates patients with psychiatric, neurovascular, tumoral, or epileptic disorders. For patients with suspected brain disorders, such as stroke, the hospital offers 24/7 access to MR and CT scanning. Interventional neuroradiology is also available for the treatment of acute stroke, intracranial aneurysms, and arteriovenous malformations.*

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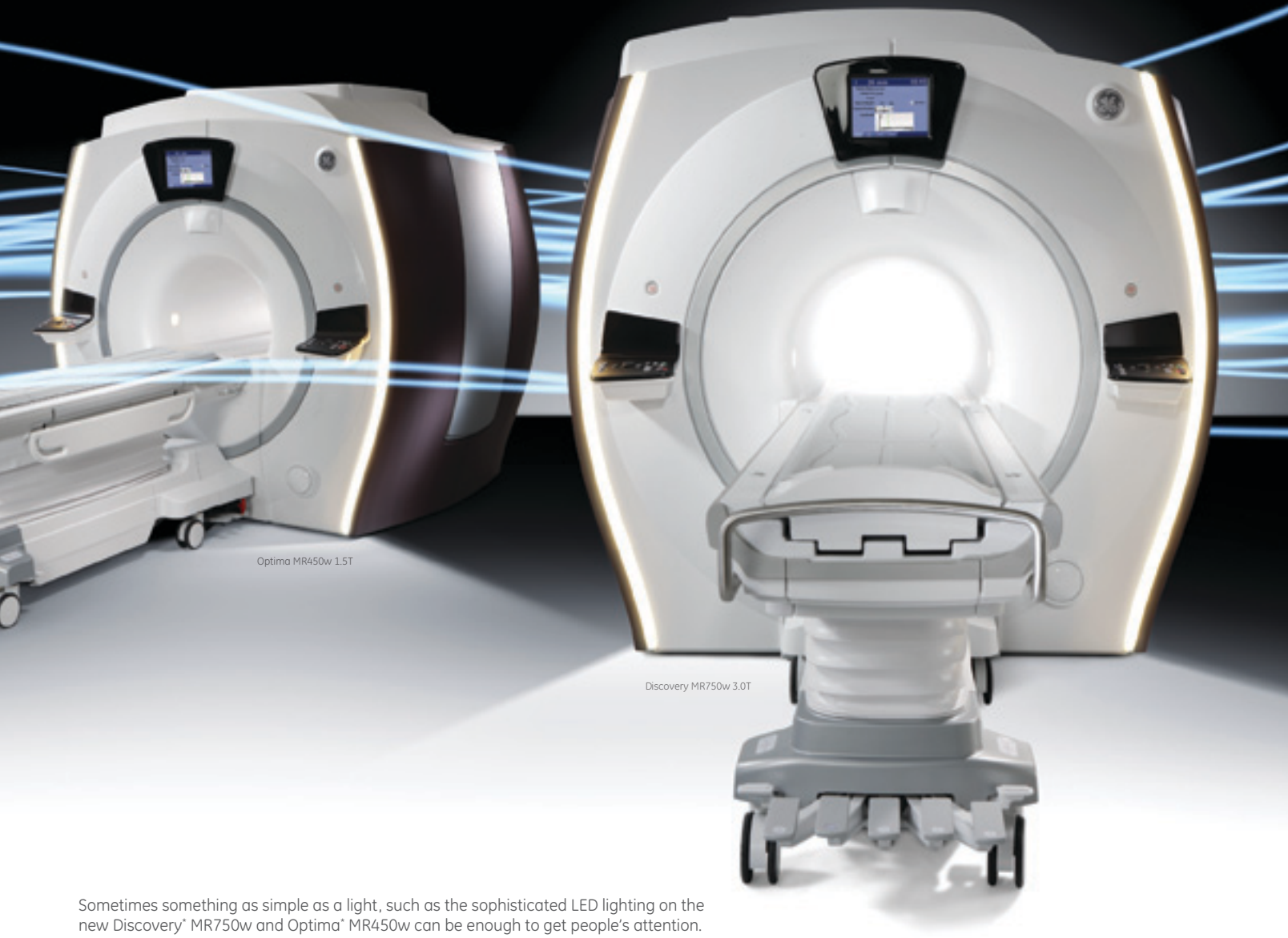

Optima MR450w 1.5T

Discovery MR750w 3.0T

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imagination at work

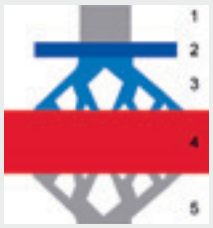
Brain Function in Pediatric Neurology: Metabolic and Perfusion Imaging

By Juan Alvarez-Linera, MD,
Chief of Neuroradiology, Ruber International Hospital

Signa* HDxt 3.0T

Hypoperfusion, or decreased blood flow, is an important characteristic of some disorders and can be seen clearly with the non-contrast 3D Arterial Spin Labeling (ASL) technique. 3D ASL labels arterial blood as it flows from the neck into the brain and provides maps of perfusion without exogenous contrast agents.

1. Arterial blood inflow
2. Spatial selective inversion pulse
3. Inverted spins
4. Brain tissue
5. Venous outflow



Patient history

A seven-year-old male underwent six month refractory crisis and showed negative results on a 1.5T MR study.

MR technique

The 8-channel brain coil was used on a Signa HDxt 3.0T system to acquire the epilepsy images. T2 FLAIR, PROBE single voxel spectroscopy, dynamic susceptibility contrast (DSC) perfusion, and 3D ASL images were obtained.

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MR parameters	
T2 FLAIR	
FOV:	22 cm
Slice thickness:	4 mm, skip 1.5 mm, 320 x 224
TR:	9500
TE:	140
Inversion:	2375
NEX:	2
BW:	62.5
PROBE Spectroscopy	
FOV:	22 cm
Slice thickness:	20 mm slice
TR:	1800
TE:	35
NEX:	8

MR parameters	
DSC	
FOV:	22 cm
Slice thickness:	7 mm, skip 0, 96 x 128
TR:	2000
TE:	Minimum
Inversion:	2375
Flip angle:	60
3D ASL	
FOV:	22 cm
Slice thickness:	4 mm, 512 x 8
Post label delay:	1025
NEX:	3
BW:	62.5

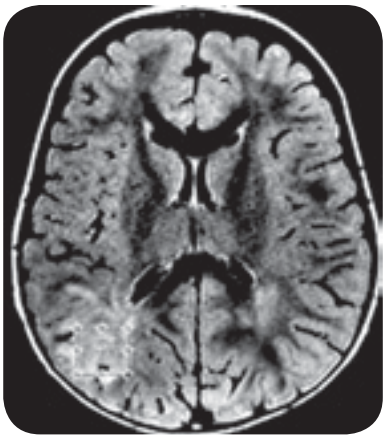

Figure 1A. FLAIR with MRS voxel in white.

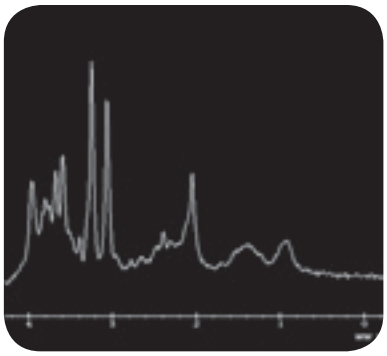

Figure 1B. Single voxel spectroscopy.

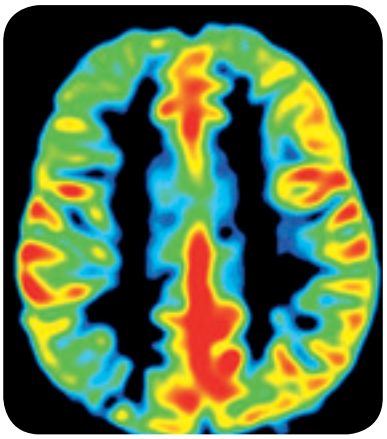

Figure 1C. CBF map from 3D ASL.

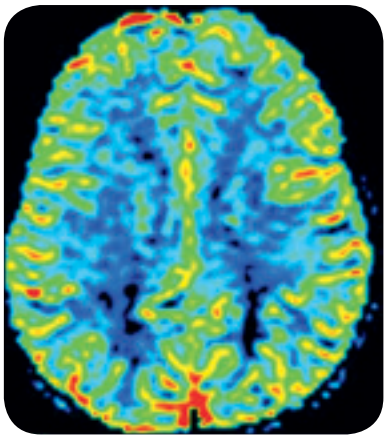

Figure 1D. rCBF map from DSC perfusion.

MR findings

High signal intensity is apparent in the right parietal lobe on the FLAIR image. Single voxel spectroscopy was acquired in this region and the resulting spectra shows decreased NAA, slightly increased Choline and Myo-inositol peaks. The non-contrast perfusion sequence provides a map of cerebral blood flow that shows focal hypoperfusion in the right parietal lobe while the DSC perfusion results do not show notable changes.

Focal cortical dysplasia in the right parietal lobe coincided with findings from video-EEG. The patient underwent surgery and is being subsequently treated with medication to improve seizures.

Juan Alvarez-Linera, MD
is the Chief of Neuroradiology at Ruber International Hospital in Madrid.

Discussion

Functional imaging can play an important role in the assessment of certain pediatric disorders. 3D ASL provides metabolic and perfusion imaging without the use of contrast, making it an excellent option for helping to understand brain function imaging in children.

Dr. Juan Alvarez-Linera *is the Chief of Neuroradiology at Ruber International Hospital in Madrid. He has a strong focus on clinical applications and also conducts research at Queen Sofía Foundation, a dementia research center focusing on Alzheimer's Disease.*

Ruber International Hospital *is a leading health care group in Spain comprised of two institutions—The Ruber International Hospital and The Ruber Clinic. The former is considered a model for its quality, advanced technology, and clinical experience. The hospital management has undergone a painstaking and rigorous selection of medical teams, insisting on health care personnel of the highest experience. This has been associated to a policy of constant investment in the most efficient and innovative medical technology.*

Utility of Breast Diffusion Weighted Imaging

By Woo Kyung Moon, MD, PhD, Professor,
Seoul National University Hospital

DWI is helpful in predicting response to chemotherapy in patients with breast cancer. The sequence can measure apparent diffusion coefficients (ADCs), which provide a quantitative measure of the diffusivity of water and, therefore, information related to tumor cellularity and the integrity of cell membranes. In addition, this method is sensitive to intratumoral changes induced by chemotherapy.

Patient history

A 45-year-old woman with biopsy confirmed invasive ductal carcinoma of the right breast. Referred for MRI including DWI and PET/CT before and after neoadjuvant chemotherapy and before surgery.

MR technique

DWI, a spin-echo single-shot echo-planar imaging sequence with diffusion-sensitizing gradients applied along the x-, y-, and z-axes (i.e. isotopic DWI), was used before and after 180-degree pulses, and these images were used to synthesize isotopic transverse images.

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To obtain diffusion weighting, the diffusion gradients can be applied in orthogonal planes or in tetrahedral.

Normal diffusion

Restricted diffusion

Diffusion is decreased in densely cellular areas, appearing bright on diffusion-weighted images and dark on apparent diffusion coefficient maps.

MR protocols DWI	
Coil:	8 ch breast
B values:	0 and 750 s/mm²
Direction:	all
Repetition time (ms/echo):	9250/60.9
Image matrix:	192 x 192
FOV:	30 cm
Slice thickness/ gap:	5 mm/0 mm
NEX:	2
ASSET:	2
Acquisition time:	80 sec

Dr. Woo Kyung Moon
is a Professor in the Department of Radiology at Seoul National University Hospital.

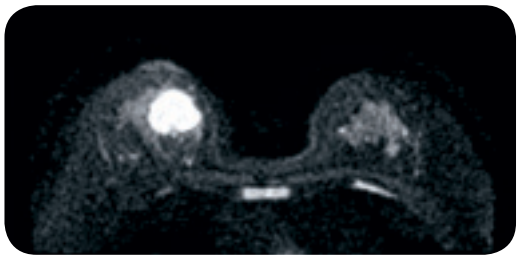

Figure 1A. The baseline transverse DWI image shows high-signal-intensity tumor in the right breast.

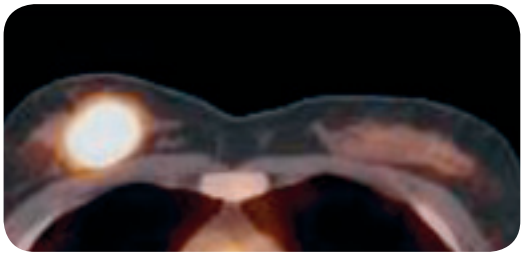

Figure 1B. The baseline transverse PET/CT image shows hypermetabolic tumor.

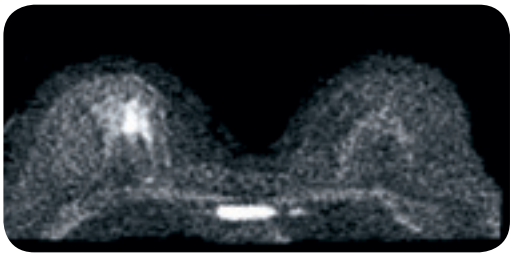

Figure 2A. The post-chemotherapy transverse DWI image shows residual high-signal-intensity tumor.

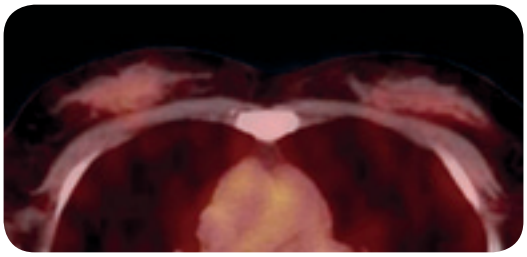

Figure 2B. The post-chemotherapy transverse PET/CT image shows no FDG uptake.

MR findings

In the baseline transverse DWI, the mean ADC of the high-signal-intensity tumor was 1.136×10–3 mm^2/s. The mean ADC of the tumor increased to 1.647×10–3 mm^2/s, and % ADC was 45.0% after chemotherapy, indicating non-complete response. The baseline transverse PET/CT image showed an abnormal FDG uptake with a maximum SUV of 5.9. The post-chemotherapy PET/CT image showed no FDG uptake, which was suggestive of complete response. The surgical histological analysis revealed a 1 cm residual invasive cancer. Patient management: breast-conserving surgery.

Discussion

The combined use of DWI and PET/CT can potentially improve specificity in predicting pCR. This can assist individualized treatment planning in breast cancer patients receiving neoadjuvant chemotherapy.

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Woo Kyung Moon, MD, PhD, *is a Professor in the Department of Radiology at Seoul National University Hospital. He received his medical and post-doctorate degrees, and completed his internship and residency at Seoul National University. Dr. Moon is an editor for The Journal of the Korean Society for Breast Screening and is on the editorial board for three SCI Journals, including Radiology, Diagnostic and Interventional Radiology, and The Korean Journal of Radiology, and also for the Journal of Korean Society of MRI. Dr. Moon's areas of interest are breast and molecular imaging.*

Seoul National University Hospital (SNUH) *now offers six main branches: with the opening of the SNU Cancer Hospital in 2011; SNU Main Hospital; SNU Children's Hospital; SNU Cancer Hospital; Seoul Metropolitan Government (SMG)-SNU Boramae Medical Center; the SNU Bundang Hospital; and the SNUH Healthcare System Gangnam Center. In addition, the SNUH Biomedical Research Institute and the SNU Cancer Hospital have established a reputation for outstanding research activities in both basic and clinical studies. With 1,435 beds (312 pediatric), SNUH treated over 588,000 inpatients and more than 2 million outpatients in 2010; the department of radiology conducted nearly 1.5 million cases.*

Conspicuity of Dural Arteriovenous Fistula

By Greg Zaharchuk, MD, PhD, Assistant Professor; Thu Le, MD, Clinical Fellow; and Ryan A. McTaggart, MD, Clinical Fellow; Department of Radiology, Stanford School of Medicine

A fistula is an abnormal connection between the arteries and veins. Dural arteriovenous fistulas (dAVF) are rare and can be treated surgically. 3D Arterial Spin Labeling (ASL) labels arterial blood as it flows from the neck into the brain and provides maps of perfusion without exogenous contrast agents and is also sensitive to detect abnormal arteriovenous connections.

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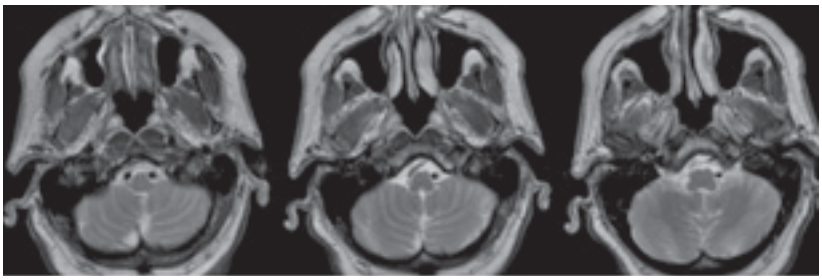


Figure 1. T2 FSE

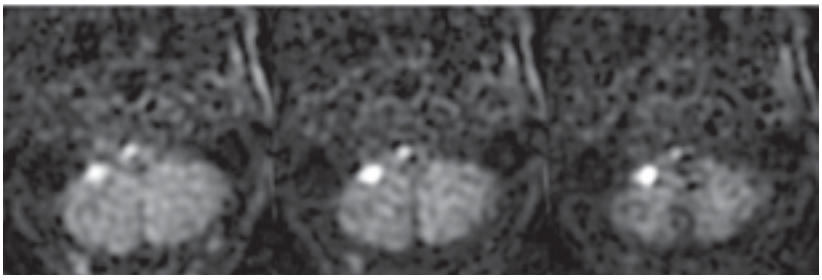


Figure 2. CBF from 3D ASL

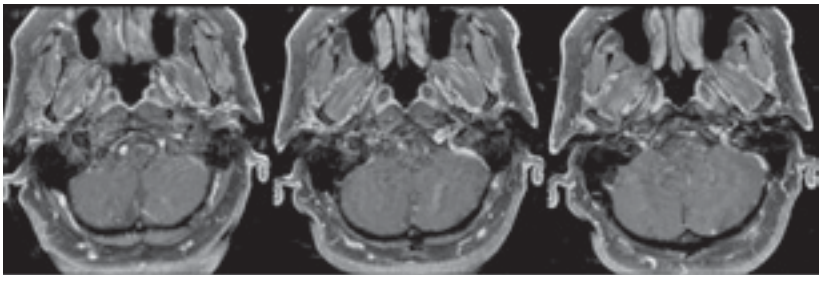
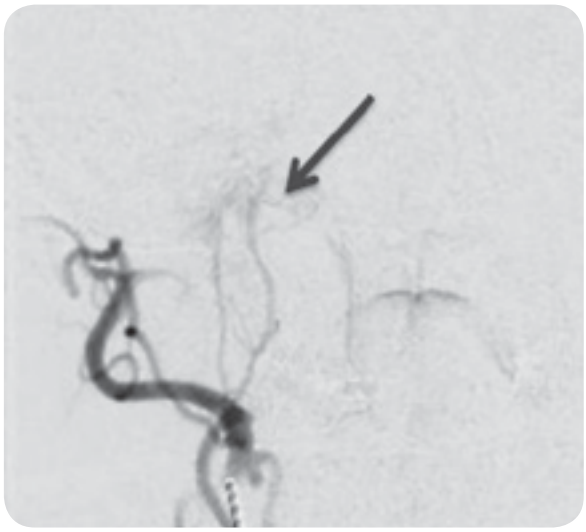


Figure 3. T1 + C

MR parameters T2 FSE	
FOV:	24
Slice:	5 mm, skip 2 mm, 512x256
TR:	3084
TE:	102
ETL:	24
BW:	31.5
3D ASL	
FOV:	22 cm
Slice:	4 mm, 512 x 8
Post label delay:	2025
NEX:	3
BW:	62.5
3D SPGR	
FOV:	24
Slice:	1.2 mm, 256x256
TR:	8.2
TE:	Min Full
Flip:	12
Prep time:	450
BW:	31.5



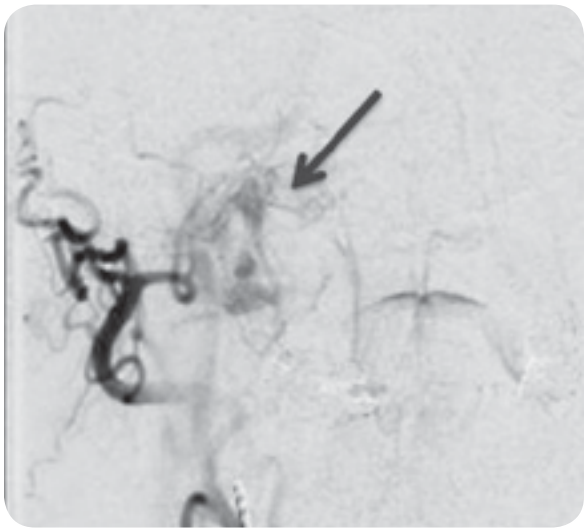


Figure 4. Angiogram from R ECA injection

Greg Zaharchuk, MD, PhD,
is an Assistant Professor of Radiology at Stanford University.

Patient history

A 76 year-old man with recent onset of right-sided tinnitus (ringing in the ear).

MR technique

An internal auditory canal protocol was scanned on the Discovery MR750, including T2 FSE and 3D ASL pre-contrast and T1 SPGR post-contrast.

MR findings

MRI was negative except for 3D ASL hyperintense signal in the right jugular region, suggestive of dAVF. CTA one week later was negative (not shown). Angiogram two weeks later demonstrates dAVF of the right marginal sinus (arrows) supplied predominantly by the ascending pharyngeal and occipital branches of the right external carotid artery.

Discussion

In this case, 3D ASL helped us identify a treatable lesion not seen on conventional techniques. By utilizing non-contrast perfusion techniques, such as 3D ASL, more subtle cases could potentially be considered, as 3D ASL does not suffer from the distortions inherent in contrast-perfusion approaches. Ⓢ

Thu Le, MD

Ryan A. McTaggart, MD

Greg Zaharchuk, MD, PhD, *is an Assistant Professor of Radiology at Stanford University. He earned his medical degree from Harvard Medical School, interned at Robert Wood Johnson University Hospital, and completed his residency and a fellowship at UCSF Medical Center. The primary focus of Dr. Zaharchuk's research is the application and technical development of advanced magnetic resonance imaging methods to assess brain hemodynamics and oxygenation in the setting of cerebrovascular disease, including Moyamoya disease, transient ischemic attack, acute ischemic stroke, and vascular malformations.*

Thu Le, MD, *is a clinical fellow in the Neuroradiology section at Stanford University Medical Center.*

Ryan A. McTaggart, MD, *is a clinical fellow in the Neuroradiology section at Stanford University Medical Center.*

Stanford University Medical Center *provides both general acute care services and tertiary medical care for patients locally, nationally, and internationally. The hospital's mission is to provide excellent care for its patients who live close by, as well as for those who come from afar for treatment of complex disorders. Consistently ranking as one of best hospitals in the US by US News and World Report and serving as the primary teaching hospital for the Stanford University School of Medicine, the hospital plays a key role in the training of physicians and other medical professionals. It provides a clinical environment for the medical school's researchers as they study ways to translate new knowledge into effective patient care.*

Free-breathing, Whole-heart Imaging in Pediatric Congenital Heart Disease

By Shreyas Vasanawala, MD, PhD,
Lucile Packard Children's Hospital at Stanford University

GE Signa* HDxt 1.5T Optima* Edition

In congenital heart diseases in pediatric patients, a 3D whole-heart overview is often useful in determining the vascular and cardiac chamber morphology. Previous techniques are often limited in spatial resolution due to the length of breath-hold and rapid cardiac motion in young patients. The new 3D Heart technique aims to provide a free-breathing method that offers both respiratory and cardiac motion suppression, along with excellent bright-blood visualization and no contrast injection.

Patient history

A six-year-old patient with a repaired atrioventricular canal defect, now with mitral regurgitation and EKG changes suggestive of infarction. MR was ordered to help rule out infarction.

MR technique

Free breathing FIESTA Cine (3 NEX), (short axis, 2 ch, 3 ch, 4 ch views). Multi-slab 3D Heart (axial whole-heart, free-breathing acquisition). Phase contrast flow imaging (aorta, pulmonary artery, tricuspid, and mitral valve). FGRE Time Course and 2D late MDE.

MR findings

MR findings suggest mitral regurgitation and a left ventricular infarct and resulting LV aneurysm. The coronary arteries were normal, and importantly, there is a right-dominant, coronary-arterial system as seen by the continuation of the distal right coronary artery to the posterolateral branch supplying the inferior left ventricular wall.

Discussion

3D Heart enables the depiction of a right-dominant, coronary-arterial system, and this, along with the relatively diminutive left circumflex artery, is helpful in planning a mitral valve repair or replacement. The coronary systems were also depicted using the free-breathing 3D Heart application. S

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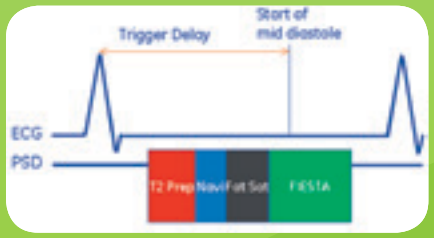
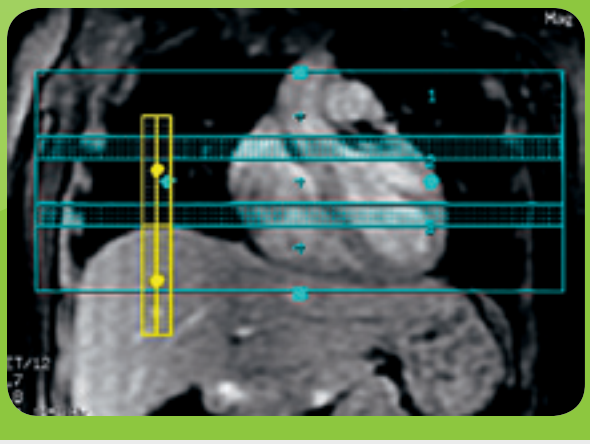
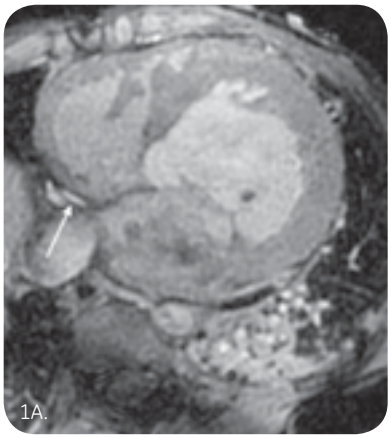
For more information:
www.tiny.cc/xa4a7

The 3D Heart application is a free-breathing, non-contrast 3D FatSat T2 prep FIESTA technique that enables clear depiction of the coronaries and cardiac chambers. Multi-slab acquisition enables high SNR and easy prescription. Real-time prospective motion correction is also applied to increase scan efficiency.





Shreyas Vasanawala, MD, PhD
is an Assistant Professor in the Department of Radiology at Stanford School of Medicine.



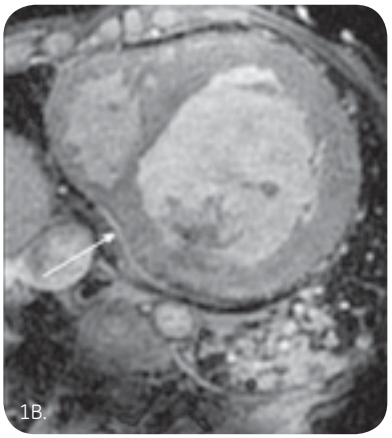


Figure 1. Right-dominant, coronary-arterial system as seen by continuation of the distal right coronary artery (arrow, 2A) to the posterolateral branch supplying the inferior left ventricular wall (arrow, 2B).

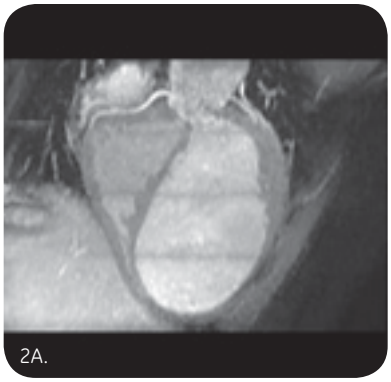


Figure 2. LV aneurysm is clearly depicted (2A); coronaries and cardiac chambers can be clearly visualized even at high heart rate of 85 to 90 bpm (2B).

MR parameters	
Scan time:	12:00
Patient position	
Patient entry:	Feet first
Patient position:	Supine
Coil:	8 CARDIAC
Plane:	Oblique
Series description:	3D Heart
Imaging parameters	
Mode:	3D
Pulse sequence:	FIESTA
Imaging options:	ECG, Nav, ZIP512, ZIP2, ASSET
Imaging options:	ECG, Nav, ZIP512, ZIP2, ASSET
Scan timing	
TE:	2.2
Number of echoes:	1
TR:	4.7
Flip:	75
BW:	125 kHz
Scan range	
FOV:	24
Slice thickness:	2
No. of slabs:	5
Locs per slab:	20
Overlap:	4
Acquisition timing	
Frequency:	256
Phase:	224
Freq direction:	L/R
Phase FOV:	0.75
Auto shim:	ON
Gating/Trigger	
Arrhyth rejec win:	20%
Trig delay:	230
# RR:	4
User CVs	
Arrhyth check:	1
Slab tracking:	1
Nav. type:	0
Nav. signal norm:	0
Slice resolution:	100

Shreyas Vasanawala, MD, PhD, *is an Assistant Professor in the Department of Radiology at Stanford School of Medicine. He joined the Department of Radiology faculty after receiving his MD and a PhD in biophysics from Stanford University, followed by residency training in radiology at Stanford University Medical Center and a pediatric radiology fellowship at Lucile Packard Children's Hospital (LPCH). During his fellowship, Dr. Vasanawala received specialty training in pediatric musculoskeletal imaging at Cincinnati Children's Hospital Medical Center and in pediatric cardiovascular imaging at Sick Kids in Toronto. At Stanford, Dr. Vasanawala's research aims to improve magnetic resonance imaging techniques for pediatric and abdominal imaging.*

Lucile Packard Children's Hospital *is an internationally recognized pediatric and obstetric hospital, and an academic medical center on the Stanford University (Palo Alto, Calif.). It serves to advance family-centered care, foster innovation, translate discoveries, and educate healthcare providers and leaders. With over 650 physicians and 4,750 staff support and volunteers, Lucile Packard Children's Hospital is a world-class, non-profit hospital devoted entirely to the care of babies, children, adolescents, and expectant mothers.*

High-resolution Knee MRI

By Richard Kijowski, MD, Associate Professor of Radiology,
University of Wisconsin School of Medicine and Public Health

Signa* HDxt 3.0T Optima* Edition

The conventional approach for a knee MRI exam is to run 2D fast spin echo (FSE) proton density FatSat series in each of the three orthogonal planes, plus the additional T1 series without fat suppression. Replacing these three orthogonal series with one single 3D data set has not yet been adopted in clinical routine, as the commercially available 3D sequences were generally based on gradient echo instead of spin echo, thus not providing the expected tissue contrast due to undesired magnetic susceptibility. Furthermore, the 3D acquisition approach often did not match the high resolution requirements expected in MSK, especially the voxel size along the slice encoding direction.

Cube is a 3D FSE sequence using a modulated refocusing RF pulse pattern to optimize image contrast and decrease blurring. Recent improvements to Cube in data acquisition limit image blurring due to shorter T2 relaxation times in MSK applications. The clinical case below illustrates the added value of Cube versus conventional 2D FSE in the knee.

MR parameters	
Repetition time:	2200 ms
Echo time:	24 ms
FOV:	15 cm 256 x 256 matrix
Slice thickness:	0.7 mm
Bandwidth:	31 kHz
Echo train length:	44
Total scan time:	5 min

Patient history

The patient is a 45 year-old male with knee pain and swelling following a twisting injury sustained while playing soccer.

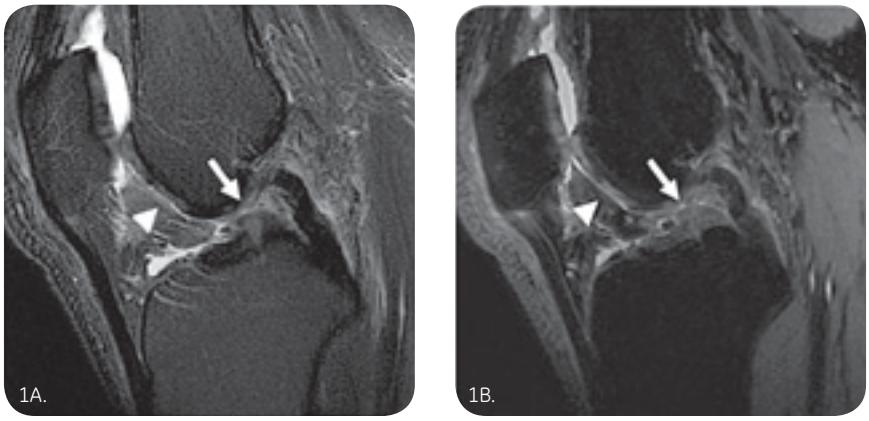


Figure 1. Sagittal fat-suppressed T2-weighted fast spin-echo image (1A) and sagittal fat-suppressed Cube FSE image (1B) show complete tear of the anterior cruciate ligament (arrow) and a partial thickness cartilage lesion on the femoral trochlea (arrowhead).

DIGITAL DIVE
For more information:
www.tiny.cc/uztgz

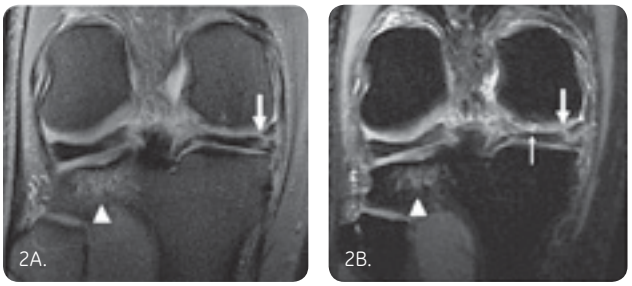


Figure 2. Coronal fat-suppressed intermediate-weighted fast spin-echo image (2A) and coronal fat-suppressed Cube FSE reformat image (2B) show a complex tear of the posterior horn of the medial mensicus (large arrow) and subchondral bone marrow edema within the lateral femoral condyle (arrowhead). Also note the tiny cartilage fissure in the medial femoral condyle (small arrow) which is better visualized on the Cube FSE image due to decreased partial volume averaging.

Richard Kijowski, MD

Is an Associate Professor, Department of Radiology, University of Wisconsin School of Medicine and Public Health and a radiologist for the University of Wisconsin Hospital & Clinics.

MR technique

A 30-minute routine knee MR protocol was performed on our Signa HDxt 3.0T scanner, consisting of two-dimensional intermediate-weighted (IW) and T2-weighted fast spin echo sequences acquired in multiple planes. A five minute 3D Cube sequence was also performed. Multi-planar 3D Cube reformat images with 1.0 mm slice thickness were created from the volumetric source data immediately following the MR examination.

MR findings

Sagittal FatSat T2 FSE image (1A) and FatSat 3D Cube image (1B) show complete tear of the anterior cruciate ligament (arrow) and a cartilage lesion on the femoral trochlea (arrowhead).

Coronal FatSat IW FSE image (2A) and FatSat 3D Cube reformat image (2B) show a complex tear of the posterior horn of the medial meniscus (arrow) and subchondral bone marrow edema within the lateral tibial plateau (arrowhead).

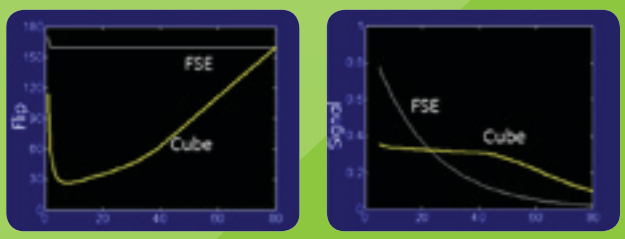
Discussion

My colleagues and I have published two large clinical studies[1,2] on patients with surgical correlation that show a five-minute 3D Cube sequence can provide similar information regarding the ligaments, menisci, and osseous structures of the knee joint as a 30-minute routine MR protocol. This case demonstrates the clinical value of Cube with significant time savings.

References

1. Kijowski R, Davis KW, Woods MA, et al. Knee Joint: Comprehensive Assessment with 3D Isotropic Resolution Fast Spin-Echo MR Imaging—Diagnostic Performance Compared with That of Conventional MR Imaging at 3.0T. Radiology 2009 Aug;251(1):185-194.

2. Kijowski R, Davis KW, Blankenbaker DG, et al. Evaluation of the menisci of the knee joint using three-dimensional isotropic resolution fast spin-echo imaging: diagnostic performance in 250 patients with surgical correlation. Skeletal Radiology 2011. Mar 12 [Epub Ahead of Print].idebar)



Cube brings together a submillimeter slice thickness capability with the fast spin echo (FSE) anatomical detail that is always expected in MSK imaging. A specific refocusing pattern exists for MSK imaging which takes into account the predominance of short T2 species.

Richard Kijowski, MD, *is an Associate Professor, Department of Radiology, University of Wisconsin School of Medicine and Public Health and a radiologist for the University of Wisconsin Hospital and Clinics. Dr. Kijowski earned his medical degree from the Loyola University Chicago Stritch School of Medicine (Maywood, Ill.) and completed his residency at Oakwood Hospital and Medical Center (Deaborn, Mich.) and the Detroit Medical Center. He has a special interest in musculoskeletal MR imaging with emphasis on the knee and elbow. Dr. Kijowski has collaborated with members of the Medical Physics Department at University of Wisconsin to develop and validate rapid three-dimensional MR techniques for joint imaging. His primary research interest is the use of morphologic and quantitative MR methods to investigate osteoarthritis and acute cartilage injury. His research efforts have lead to 49 scientific abstracts presented at national and international meetings and 30 articles published in peer reviewed journals.*

UW Health *represents the academic health care entities of the University of Wisconsin-Madison: UW Medical Foundation, UW Hospital and Clinics, UW School of Medicine and Public Health, American Family Children's Hospital and UW Carbone Cancer Center. Our expert doctors are at the forefront of research, developing new treatments and training the next generation of physicians. Together with other health care professionals, they serve the health needs of Wisconsin, and beyond.*

Discovery* MR750 3.0T

NCE Imaging of Complex Vascular Disease: Inhance 3D Deltaflow

By Professor Wladyslaw Gedroyc, MBBS, MRCP, FRCR,
Medical Director of MRI, St. Mary's Hospital

Inhance 3D Deltaflow is a 3D, FSE-based technique developed for non-contrast peripheral angiography. It utilizes the difference in arterial and venous flow patterns during systolic and diastolic phase. Two sets of images are acquired during systolic and diastolic phases and subtracted to generate an MR arteriogram.

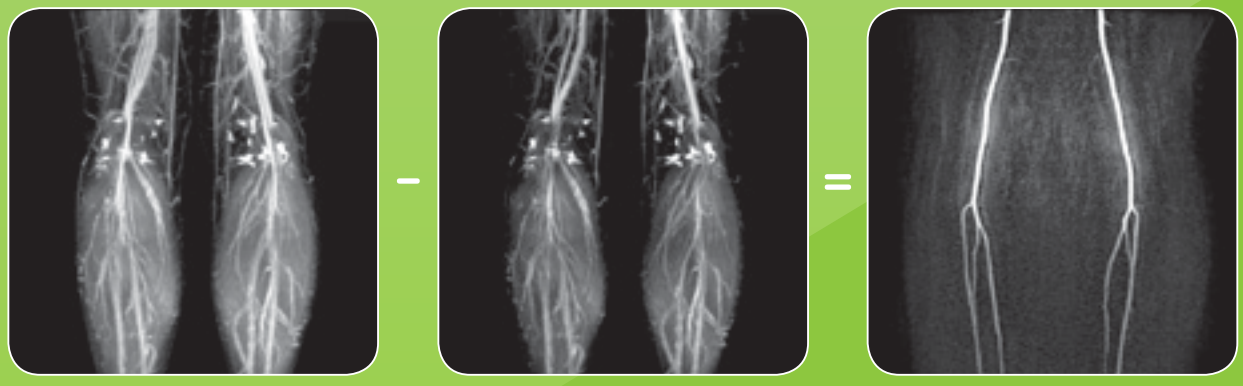
Patient history

A 69 year-old male with vascular disease in the lower limbs. Due to a poor GFR score, this patient was not a candidate for peripheral MR arteriography with gadolinium.

Professor Wladyslaw Gedroyc, MBBS, MRCP, FRCR,
is Medical Director of MRI at St. Mary's Hospital (London) and Professor of Radiology at Imperial College (London).

MR technique

Inhance 3D Deltaflow sequence with peripheral gating was performed over the femoral arteries and then repeated over the tibial arteries.



Diastolic — Systolic — Inhance 3D Deltaflow

Inhance 3D Deltaflow is a 3D, FSE-based technique developed for non-contrast peripheral angiography. It utilizes the difference in arterial and venous flow patterns during systolic and diastolic phase. Two sets of images are acquired during systolic and diastolic phases and subtracted to generate arteriography.

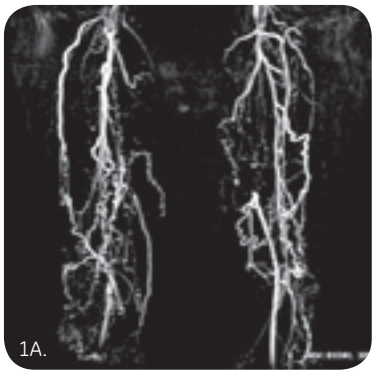


Figure 1. Superficial femoral arteries are occluded (A); Occlusion of the posterior tibial artery (B).

MR parameters	
Scan time:	4:34 (per station)
Patient position	
Patient entry:	Feet-first
Patient position:	Supine
Coil:	8 ch body full FOV
Plane:	Oblique coronal
Series description:	Inhance 3D Deltaflow
Imaging parameters	
Mode:	3D
Pulse sequence:	CUBE T2
Imaging options:	Gat, EDR, Fast, ZIP512, ZIP2, Asset, FR
Scan timing	
TE:	38.4
Number of echoes:	N/A
TR:	~3000
BW:	62.5 kHz
Scan range	
FOV:	48
Phase FOV:	0.9
Slice thickness:	3
Acquisition timing	
Frequency:	320
Phase:	224
NEX:	0.5
Freq dir:	S/I
Auto shim:	ON
Gating/Trigger	
Gating:	PG
Trigger window:	20%
Sys trigger delay:	Min
Dias trigger delay:	536
# RR:	2

MR findings

Arterial occlusions are observed in two patients using Inhance 3D Deltaflow. In the first patient (Figure 1A), the superficial femoral arteries are occluded from the origin down to the adductor hiatus on the left side and down to the popliteal artery on the right side. In the second patient (Figure 1B), the right anterior tibial artery is visible to the foot, yet demonstrates occlusion of the posterior tibial artery. The left posterior tibial artery is visible to the foot, but the left anterior tibial artery and common peroneal artery are occluded.

Discussion

Inhance 3D Deltaflow is an excellent non-contrast sequence for visualizing complex vascular disease. It helps allow consistent visualization of all arterial vasculature below the knee without the difficulty of venous contamination that often occurs in contrast examinations, making assessments problematic.

With this sequence, we can easily and reliably image arterial vasculature below the knee, which is usually the most difficult portion of the arterial tree to visualize, without using MR contrast agents that can lead to adverse side effects in renal failure patients. This represents a significant achievement in the imaging of the peripheral arterial circulation.

DIGITAL DIVE
For more information:
www.tiny.cc/mwnui

Wladyslaw Gedroyc, MBBS, MRCP, FRCR, *radiologist, is Medical Director of MRI at St. Mary's Hospital (London) and Professor of Radiology at Imperial College (London). He has vast experience in vascular imaging, especially in renal artery diseases and renal transplant. Professor Gedroyc has published over 80 papers in peer reviewed journals related to vascular MRI, interventional focus ultrasound, and other MR related topics.*

St Mary's Hospital *is one of the five hospitals under the Imperial College Healthcare NHS Trust. It is a general acute hospital that diagnoses and treats a range of adult and paediatric conditions. Now one of the largest NHS trusts in the country, it has come together with the College to establish one of the UK's first academic health science centres (AHSCs) for advancement in patient care, clinical teaching and scientific invention and innovation.*

Discovery* MR750 3.0T

Value of T1, T2, and Diffusion-weighted Imaging at 3.0T

By Bachir Taouli, MD, Director of Body MRI,
The Mount Sinai Medical Center

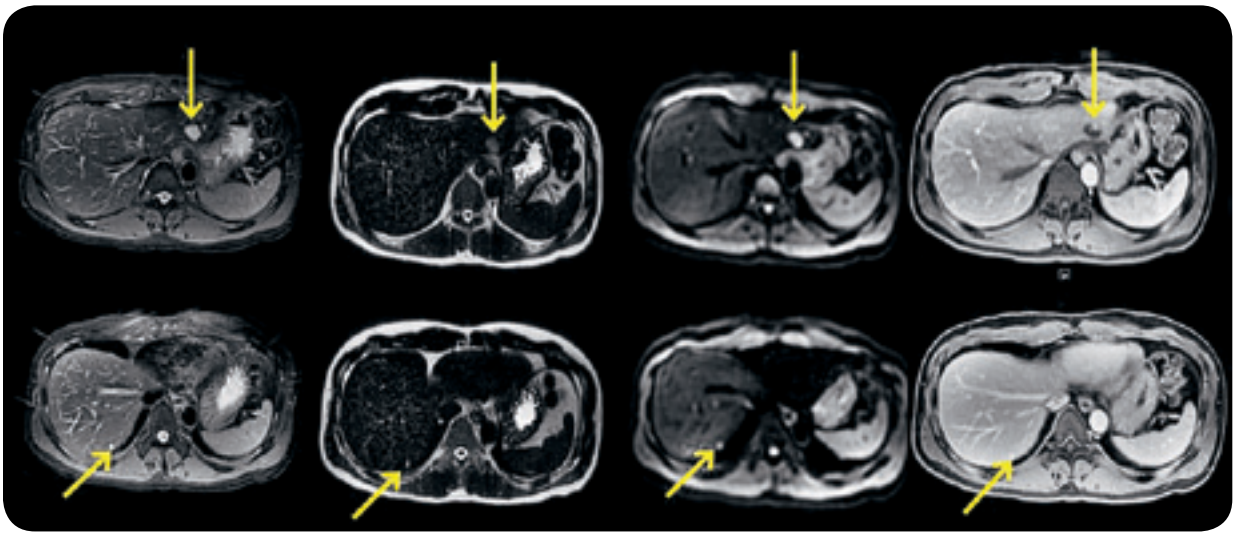
The combination of T2w, DWI, and contrast-enhanced T1w is essential for liver lesion detection and characterization, enabling extremely high diagnostic accuracy.

Patient history

The patient was referred to MRI for characterization of small hepatic lesions diagnosed on CT.

MR technique

2D SSFSE (TE 240 ms) and PROPELLER 3.0 FSE for T2w scans, LAVA for dynamic T1w, and eDWI for diffusion weighted were utilized. Respiratory triggering was deployed with PROPELLER 3.0 FSE and eDWI scans. SSFSE and LAVA were breath-hold. eDWI was obtained using SS EPI with b values of 0, 50, 500 and 1000 s/mm^2. Small diffusion gradients (b=50) provide black blood images, which increase liver lesion conspicuity especially for lesions near hepatic vessels, compared to standard FSE T2w.



PROPELLER 3.0 | SSFSE (long TE) | DWI (b=50) | LAVA (portal venous)

DIGITAL DIVE
For more information:
www.tiny.cc/5wwto

Bachir Taouli, MD

is an Associate Professor of Radiology and Medicine and Director of Body MRI, in the Department of Radiology at Mount Sinai School of Medicine and The Mount Sinai Hospital (New York).

MR findings

MR revealed two small lesions. Low b value (b=50) DWI was useful in detecting the lesions as it provides dark blood and bright lesion contrast. Hyperintense signal on SSFSE and PROPELLER 3.0, and progressive enhancement post extracellular gadolinium contrast injection on the T1w LAVA images confirmed the diagnosis of hemangiomas (segments 2 and 7).

Discussion

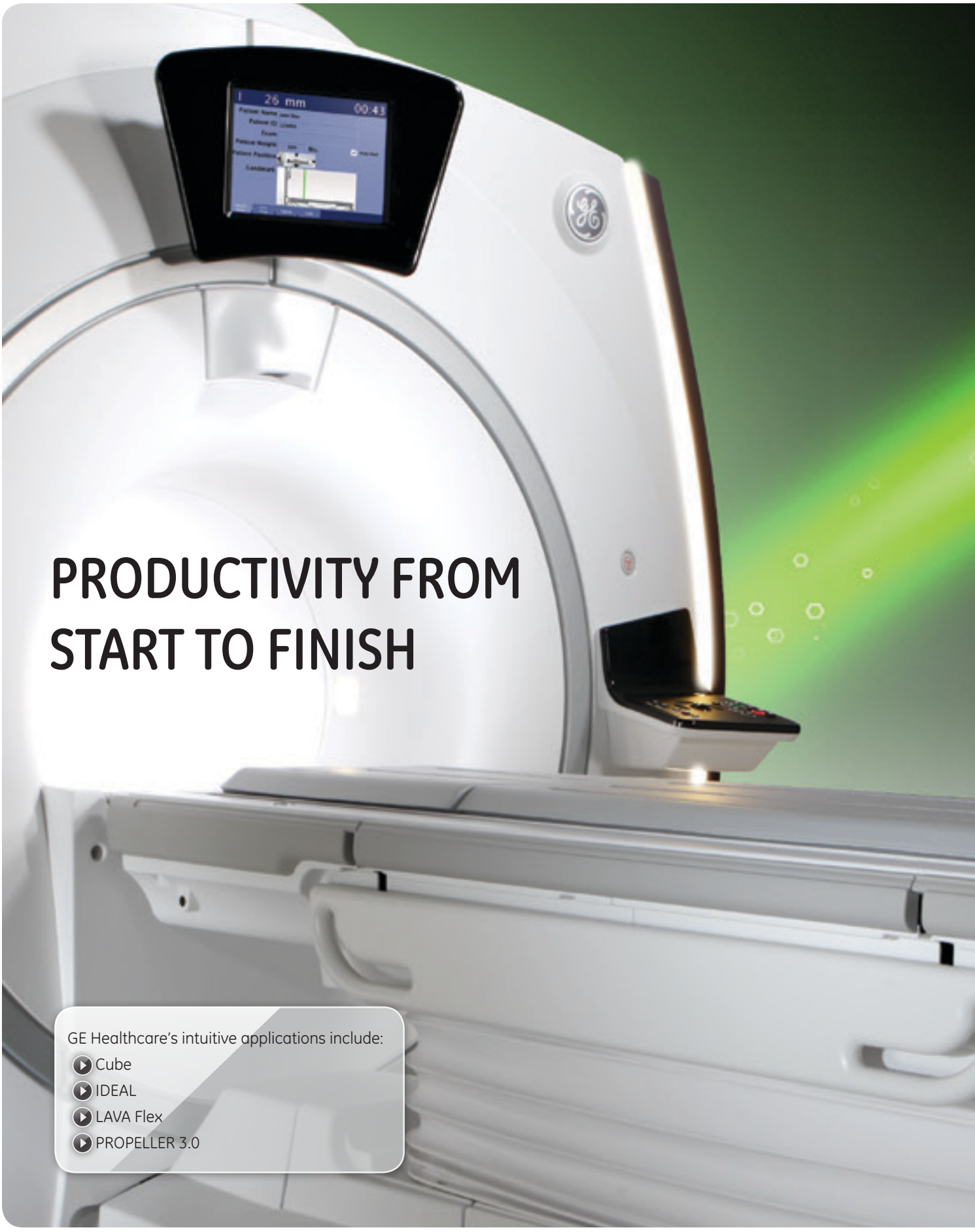
The combination of T2w, DWI, and contrast-enhanced T1w is excellent for liver lesion detection and characterization, helping enable high diagnostic accuracy. PROPELLER 3.0 utilizes mutual information from overlapping regions to increase robustness against motion artifacts. In this particular case, MRI helped establish a benign diagnosis, avoiding unnecessary follow-up or invasive biopsy.

MR parameters	
FSE PROPELLER respiratory triggered	
TR:	6000
TE:	100.0
Matrix:	256 x 256
Slice thickness:	7 mm
Plane:	axial
FOV:	330
Coil:	32 channel
Acquisition time:	approx 2 min

PROPELLER 3.0's innovative trajectory is formed by combining individual blades that overlap in the center of k-space.

Bachir Taouli, MD, *is an Associate Professor of Radiology and Medicine and Director of Body MRI, in the Department of Radiology at Mount Sinai School of Medicine and The Mount Sinai Hospital (New York). Dr. Taouli completed his radiology residency at Paris VI University (France). After a Fellowship in Abdominal Radiology at UCSF, he joined the Abdominal Imaging/Body MRI section at NYU before moving to Mount Sinai School of Medicine. Dr Taouli 's areas of interest include advanced MRI applications in the abdomen and pelvis. He is an abstract reviewer for ISMRM, RSNA, ARRS, and SGR. He has authored over 75 peer-reviewed manuscripts and book chapters primarily on body MRI.*

Mount Sinai Medical Center, *named to U.S. News & World Report's 2009–2010 Best Hospitals Honor Roll and ranked 19th nationally, treats nearly 47,000 inpatients and 427,000 outpatients each year. Renowned for its spinal cord and brain injury rehabilitation, Mount Sinai was the first medical school to establish a Department of Geriatrics, as well as departments of environmental and occupational medicine. With more than 3,000 fulltime and voluntary physicians on staff, the hospital is a regional leader in numerous specialties and the world's only center for the diagnosis and care of Jewish genetic diseases.*



PRODUCTIVITY FROM START TO FINISH

GE Healthcare's intuitive applications include:

- Cube
- IDEAL
- LAVA Flex
- PROPELLER 3.0

> "With this new system we've seen fantastic image quality. The scanner is patient friendly, and the coils are ergonomic and easy to use."
>
> *Howard Thomas, MR Superintendent of Prince Phillip Hospital*

Imagine what can happen when an MR workflow is designed to benefit everyone involved in the scanning process. With the aesthetic redesign of the Optima* MR450w, a new wide bore system, and addition of the Geometry Embracing Method (GEM) Suite, GE Healthcare has committed to a focus on the human element. In that vein, GEM-enabled workflow gives equal priority to patient, technologist, and radiologist needs. Early adopters of GEM-enabled workflow are reporting that it can have a significant impact on a facility's bottom-line. Howard Thomas, MR Superintendent of Prince Phillip Hospital (Llanelli Wales), weighs in on what he's seen at his hospital after an Optima MR450w system with GEM Suite was recently installed.

"With this new system we've seen fantastic image quality. The scanner is patient friendly, and the coils are ergonomic and easy to use. The software is easy for the operator to use as well. I feel that the GEM Suite has greatly improved our productivity without any reduction in image quality," Thomas said, noting that his facility has observed up to a 62% reduction in scan time for foot and pelvic exams using the GEM Suite.

How does GEM-enabled workflow differ from other MR workflows? Baldev Ahluwalia, MR Product Manager, GE Healthcare explains the design approach. "Our design focused on addressing the needs of each individual patient. With this focus, the GEM solution helps address the needs of everyone—from patient to technologist to physician to administrator."

Workflow starts before scanning begins

To optimize MR workflow, GE Healthcare examined and optimized the process from the first interaction the patient has with the technologist. Here, GE's detachable GEM Express patient table can help minimize set up time. The table has a standard 205 cm scanning range, 500 lb. lift capability, and IntelliTouch landmarking. Also, the GEM coils in the table are fully integrated, lightweight, and designed to accommodate a wide variety of patient shapes and sizes. The pads and ergonomic coils are comfortable, making it easier to reposition the patient and may also reduce the frequency of repeat exams due to patient motion. Another benefit of the table is that the anterior and posterior array allows feet-first or head-first imaging for all exams.

When evaluating workflow, engineers also addressed in-room controls. The in-room operators console (iROC) is a GE innovation that works together with the IntelliTouch feature to help efficiently position the patient. The iROC also displays helpful information such as cardiac and respiratory waveforms, and can even help guide biopsy procedures.

> "We're confident that this workflow addresses the needs of everyone—from patient to technologist to physician to administrator."

Baldev Ahluwalia, Global 1.5T MR Product Manager

Expedient exam prescription

The productivity enhancements contained in GEM are reflected not only in the ergonomic hardware elements surrounding the patient table and surface coils, but also in a significant number of time-saving user interface features that flexibly adapt to the needs of both the patient and the MR operator. GEM workflow holistically integrates protocol selection, field-of-view (FOV), and coil element selection with AutoCoil, slice alignment with ReadyBrain, and overall protocol management. With the Linking feature, the entire protocol can be modified with single adjustments to slice alignment and other preferences, rather than requiring the user to manage each series individually. In addition, the Protocol Notes feature enables users to visually record and transmit best practices and site preferences from user to user.

These advantages are standard with GEM systems and are designed to help improve productivity from day one, without necessitating extensive up-front time investment to "train" the system.

An optimized acquisition

To optimize the actual scanning process for the human element, GEM-enabled workflow utilizes the latest in GE MR applications technology in acquiring high quality images and the most information with the fewest scans.

GE Healthcare's intuitive applications include:

Cube—can replace multiple 2D acquisitions with a single 3D volume scan.

IDEAL—a GE-exclusive fat and water separation technique that results in four contrasts (water-only, fat-only, in-phase, and out-of-phase) all from one acquisition.

LAVA Flex—combines the benefits of LAVA with IDEAL to generate four contrasts in one breath hold, reducing series and exam time. LAVA Flex delivers consistent and uniform fat suppression over the entire FOV.

PROPELLER 3.0—designed to help reduce rescans due to patient motion. It is available in any anatomy, including body, spine, and shoulder.

Ready when you are

When optimizing the review stage of scanning, GE Healthcare focused on READY View, a post-processing platform on Advantage Workstation, which enables a fast, easy, and quantified analysis of images. READY View is sometimes described as a one-stop shop for post-processing, and much of it is automatic so there are fewer possible errors for the technician or physician to make. To further efficiency, GEM workflow deploys inline post-processing, a feature that allows the user to process all functional data on a single screen. For more information on READY View, see page 38.

Feedback just beginning to roll in

Prince Phillip Hospital is one of the first customers to begin reporting measured productivity increases with GEM-optimized workflow, but the product development team is expecting there will be many more. "We're confident that this workflow addresses the needs of everyone—from patient to technologist to physician to administrator," said Ahluwalia. "With a formula like that, everybody wins."

Sharp images with the Optima MR450w with GEM

All images courtesy of CHR Laennec

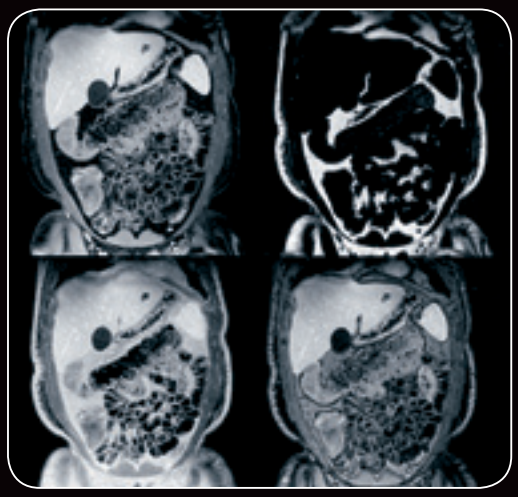


Figure 1. Coronal abdominal study with LAVA Flex, demonstrating large FOV capabilities of the GEM AA, and revealing dilated loops of the small bowel and terminal ileum.

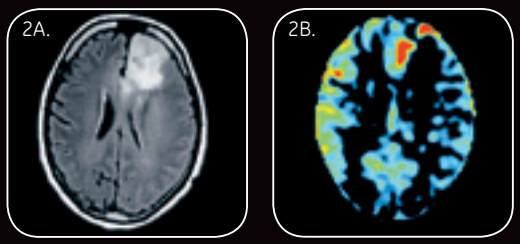


Figure 2. T2 FLAIR PROPELLER (2A) and 3D ASL (2B). 3D ASL with cerebral blood flow map shows an increase in brain perfusion at the location of a brain tumor.

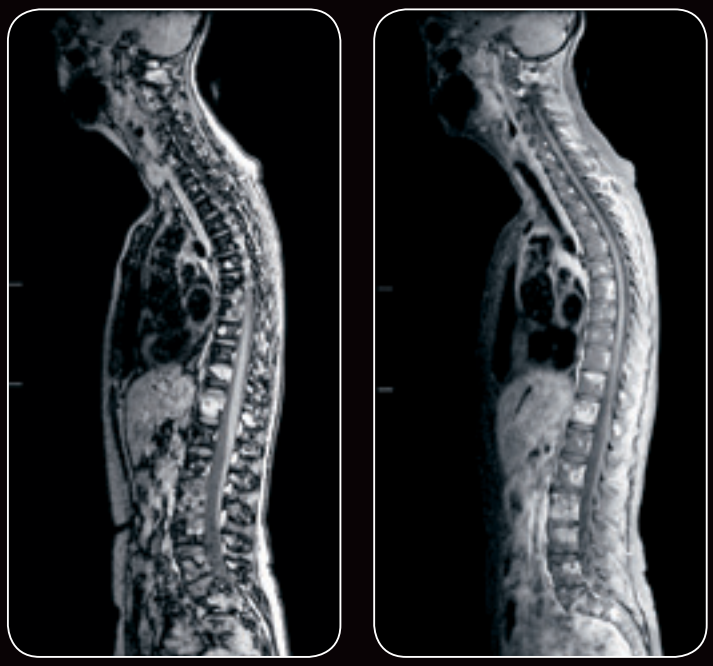


Figure 3. Patient with metastatic bone disease. T1 FSE with IDEAL, (out-of-phase and water images) demonstrating marrow changes throughout the spinal column.

After a recent install at CHR Laennec (Creil, France), clinicians are sharing initial impressions of the Optima MR450w with GEM Suite.

Jean-Marc Pinon, Radiology Manager of the CT and MR imaging center and Hervé Hatier, MD, MR and CT Administrator, at CHR Laennec, report that along with improvements to workflow, they are also very impressed with the system's image quality. According to Pinon, patients like the look of the system and appreciate that exams can be performed feet-first.

But technologists and radiologists like the system for other reasons. "GEM offers a more comfortable patient set-up but also impacts image quality," Pinon said. He explains that GEM and GEM Flex Coils are lightweight and designed to fit closer to the anatomy, providing better signal-to-noise ratios (SNR). Says Pinon, "The first results show a clear increase of the signal, resulting in crisper and sharper images. And this level of image quality is found in all anatomies we've scanned, even in the most challenging areas like the heart or the abdomen."

He noted that with the SNR improvements, radiologists and technicians have two imaging options: increase image resolution to view more detailed anatomy or shorten the scan time. The latter enables CHR Laennec to either conduct additional sequences on a patient or scan more patients. "GEM Suite becomes a powerful tool to help reduce patient backlog and increase access to MR for more patients every day in our region," adds Pinon.

GE HEALTHCARE INVESTING $1 BILLION TO EXPAND ADVANCED CANCER DIAGNOSTIC, MOLECULAR IMAGING CAPABILITIES

> "Hyperpolarization shows much promise for imaging metabolic synthesis to identify the early footprint of disease."
>
> *Jason Polzin, PhD, Chief Engineer, Software & Aplications, Global MR at GE Healthcare*

GE Healthcare recently announced that it is dedicating $1 billion of its total R&D budget over the next five years to expand its advanced cancer diagnostic and molecular imaging capabilities, as well as its world-class technologies for the manufacture of biopharmaceuticals and cancer research. The company is a leader in diagnostic imaging for the detection of cancer and is a leading provider of technologies for cancer research and biopharmaceutical manufacturing.

In MR, this reinforces our focus on the development of technologies such as metabolic imaging with hyperpolarized Carbon 13‡‡ (C13) for research and biopharm manufacturing activities.

GE Healthcare has patented an approach to Metabolic MRI using hyperpolarized agents. SPINlab™ harnesses hyperpolarized C13 to view metabolic processes in real time, using advanced GE MR technology for functional metabolic imaging. This approach increases the MR signal more than 20,000 times for studying real-time metabolism of disease, opening up new possibilities for MR imaging to move beyond morphology and functionality onto a new platform that may help clinicians visualize information about flow, perfusion, excretory function, and organ and cell viability in living creatures.

Metabolic MRI with hyperpolarized agents shows promise by helping support the differentiation of benign and malignant lesions, separating aggressive from slow-growth tumors and facilitating non-invasive treatments. The vision of Metabolic MRI with hyperpolarized C13 is to measure the biochemical "fingerprint" of tissue for earlier diagnosis and improved staging, and to influence treatment decisions.

"Hyperpolarization shows much promise for imaging metabolic synthesis to identify the early footprint of disease," says Jason Polzin, PhD, Chief Engineer, Software & Applications, Global MR at GE Healthcare. "To make this research a reality, GE has integrated its Biosciences and Engineering technology with advances in MR imaging. The Signa* MR750 3.0T MR system provides ultra-fast imaging and the multi-channel, multi-nuclear capabilities required to visualize cell metabolism using C13."

In collaboration with the University of California, San Francisco (UCSF), GE Healthcare and GE Global Research are developing new C13-based agents for metabolic imaging. University researchers recently announced promising results from a study of prostate cancer utilizing GE's C13 technology, where real-time metabolic imaging of a human patient was conducted for the first time. A member of the UCSF research team describes it as a groundbreaking approach to understanding the precise margins of a tumor, how fast the tumor is growing, and how well it responds to treatment.

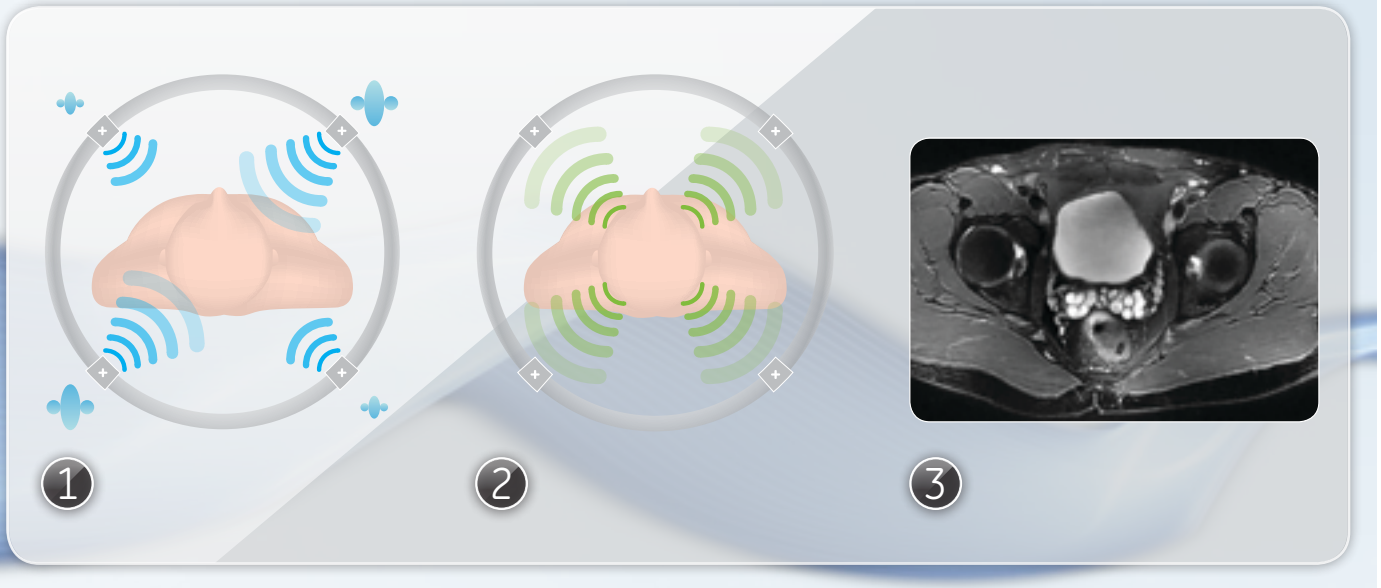
To further accelerate and help enhance the development of Metabolic Imaging and other innovative technology, GE has launched a new entity, Research Circle Technology Inc. (RCT). RCT's vision is to create a strong alliance between GE's scientists and the world's leading universities, providing easy access to GE's organic technology and wide scope of healthcare expertise in an open innovation structure.

‡‡CAUTION: Sterile compounding equipment. Output of this equipment may only be used for human applications under an approved research study (IND or equivalent).

MULTIDRIVE: AN AUTOMATED PARALLEL RF TRANSMIT FOR OPTIMIZING B1 AT 3.0T

Insight...

1. MultiDrive ensures the phase and amplitude of each RF pulse are adapted for the anatomy of interest.
2. MultiDrive's RF modification produces uniform MR signal during reception.
3. MultiDrive automatically compensates and virtually eliminates B1-induced signal shading across different body shapes and sizes. The result is consistently clear and uniform images.



The leap in image quality from 1.5T to 3.0T is unquestionable, yet as MR technology improves, new challenges continue to present themselves.

Shading artifacts are more challenging at 3.0T than 1.5T, particularly with abdominal scans. Wide bore MR systems further complicate this issue, since at 70 cm the space between the RF coil and RF shield diminishes, requiring more precise control over the RF transmit system. To help solve this issue and unleash the power of 3.0T on the Discovery* MR750w, GE Healthcare introduces the MultiDrive RF system, an independent RF pulse control, and a new whole-body, 4-port drive RF coil design. Together, these innovations improve signal uniformity across the FOV regardless of patient size.

Here's how it works. The MultiDrive RF transmit system uses independent exciters to generate RF pulse waveform shape, amplitude, and pulse phase. The phase is simply the relative delay, in time, of the pulses relative to each other. Each RF pulse is sent to independent RF amplifiers before being applied to each of the four drive ports of the RF transmit coil. With this parallel transmit architecture, the Discovery MR750w system automatically compensates and eliminates B1-induced signal shading introduced by different body shapes and sizes.

MultiDrive has two distinct modes of operation. The "preset mode" utilizes predetermined RF amplitude and phase settings to generate the best possible image quality over a broad range of patients. These values were optimized for the general population by calculating the optimal RF settings and then averaging the results. This mode requires no additional pre-scan and minimizes the required RF power and SAR needed to create uniform images.

A "per-patient optimization" mode can be selected by the user to optimize the RF system for each individual patient, if desired. It executes a rapid, 10 to 15 second calibration scan to create an RF flip angle (B1) map over the region of interest. At the completion of the scan, the system automatically calculates the optimal RF amplitude and phase values based on the B1 map data. This mode is useful for challenging studies, such as extremely obese patients or when ascites is present.

The result is a productive yet flexible approach to accommodating any patient size, shape, and type, to improve RF uniformity without sacrificing image quality or patient safety. S

Acknowledgement:

The editor sincerely acknowledges the direction and input of Bryan Mock, PhD, Global 3.0T MR Product Manager, GE Healthcare, in crafting this article.

MRgFUS IN INDIA

Jaslok Hospital Implements Life-changing Procedure for Patients

Women in India now have a choice when it comes to seeking treatment for uterine fibroids.

At Jaslok Hospital and Research Centre (Mumbai), patients suffering from this condition were historically treated with surgery and, in a few instances, uterine artery embolization. That all changed once the hospital installed ExAblate, an MR guided focused ultrasound (MRgFUS) system.

MRgFUS is exclusive to GE MR systems and offered through a collaboration between GE MR and InSightec's ExAblate system, which uses high-intensity ultrasound beams to heat and destroy fibroid tissue. This unique "scalpel-less" procedure engages MR to visualize patient anatomy with high precision, map the volume of fibroid tissue to be treated, and monitors the temperature of the uterine tissue after heating.

"I keenly watched the progress of MRgFUS over a period of two years and was fascinated and impressed with the technology, the concept, its effectiveness, and utility," says Shrinivas B. Desai, MD, Director, Department of Imaging & Interventional Radiology at Jaslok Hospital. "I was fairly convinced that this technology would have a profound impact on patient management at Jaslok in the future."

A profound impact may be an understatement. While other treatment options such as surgery, hormone therapy, and invasive arterial embolization exist, Dr. Desai's patients often don't want to undergo invasive procedures, general anesthesia, or radiation.

Women are decidedly more willing to undergo MRgFUS than other invasive procedures, notes Dr. Desai. "Ease of treatment, short duration of treatment, and absence of any invasive surgery or intervention has a very positive impact on patient outcome," he adds. "The response to the treatment has ranged from satisfactory to good, with a large number of patients experiencing symptom relief by their next menstrual cycle."

Uterine fibroid symptoms include excessive bleeding, backache, constipation, recurrent urinary tract infection, anemia, and pain in the abdomen. The severity of these symptoms can be debilitating in many of the patients, completely disrupting their normal routine and work.

Dr. Desai finds the ExAblate system very easy to use and effective. "The system has sub-centimeter precision in ablating the fibroids while preserving adjacent normal structures, resulting in excellent therapeutic response." As with any medical procedure, the potential for complications exists and he advises his patients of this. However, Dr. Desai has found that adhering to basic standard precautions and carefully monitoring the entire treatment helps avoid complications.

> "I would strongly recommend treatment by MRgFUS to any other woman who is suffering from uterine fibroids."
>
> *Jaslok Hospital patient*

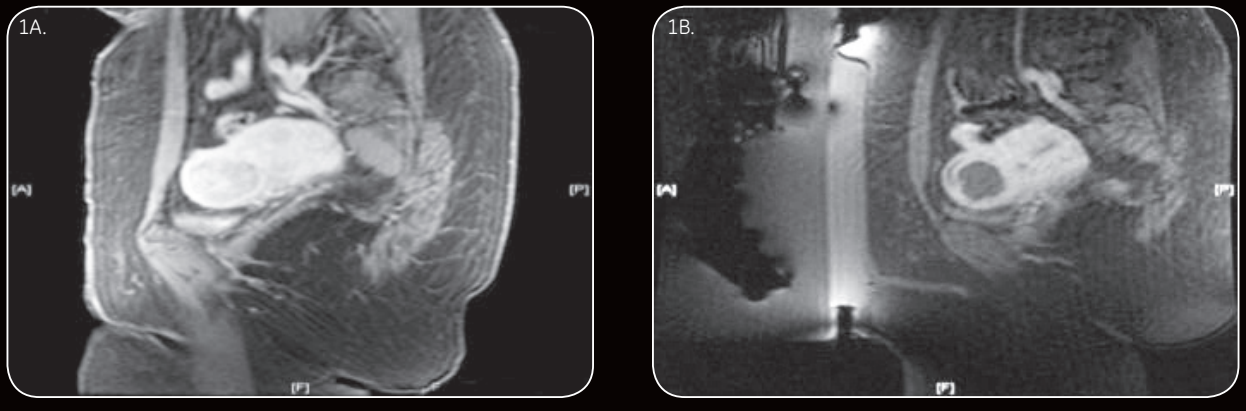


Figure 1. A 35 year-old female with heavy bleeding and severe abdominal pain during menstruation. Diagnosed with a single uterine fibroid. Pre-treatment, T1w contrast (1A) and post-treatment, T1w contrast (1B). Symptom and significant size reduction of fibroid at one month follow-up.

> "I keenly watched the progress of MRgFUS over a period of two years and was fascinated and impressed with the technology, the concept, its effectiveness, and utility."
>
> *Dr. Shrinivas B. Desai*

"Careful monitoring of online MR thermometry will result in complete thermal ablation of the tumor and is extremely easy to achieve," Dr. Desai says. "There is a radical and palpable change in the treatment of fibroids with MRgFUS."

Jaslok Hospital is raising awareness of the uterine-sparing procedure and its benefits, as many medical professionals—much less the general public—are aware of it. Efforts include interviews in print media and television, participating in health talks and discussions, presenting data on MRgFUS at conferences, implementing a Web site dedicated to FUS, and distributing a detailed informational brochure to different medical professionals.

These efforts have paid off, according to Dr. Desai. "We are witnessing increased referrals for gynecological disorders and the addition of a therapeutic procedure is enhancing our hospital's and department's reputation among our peers."

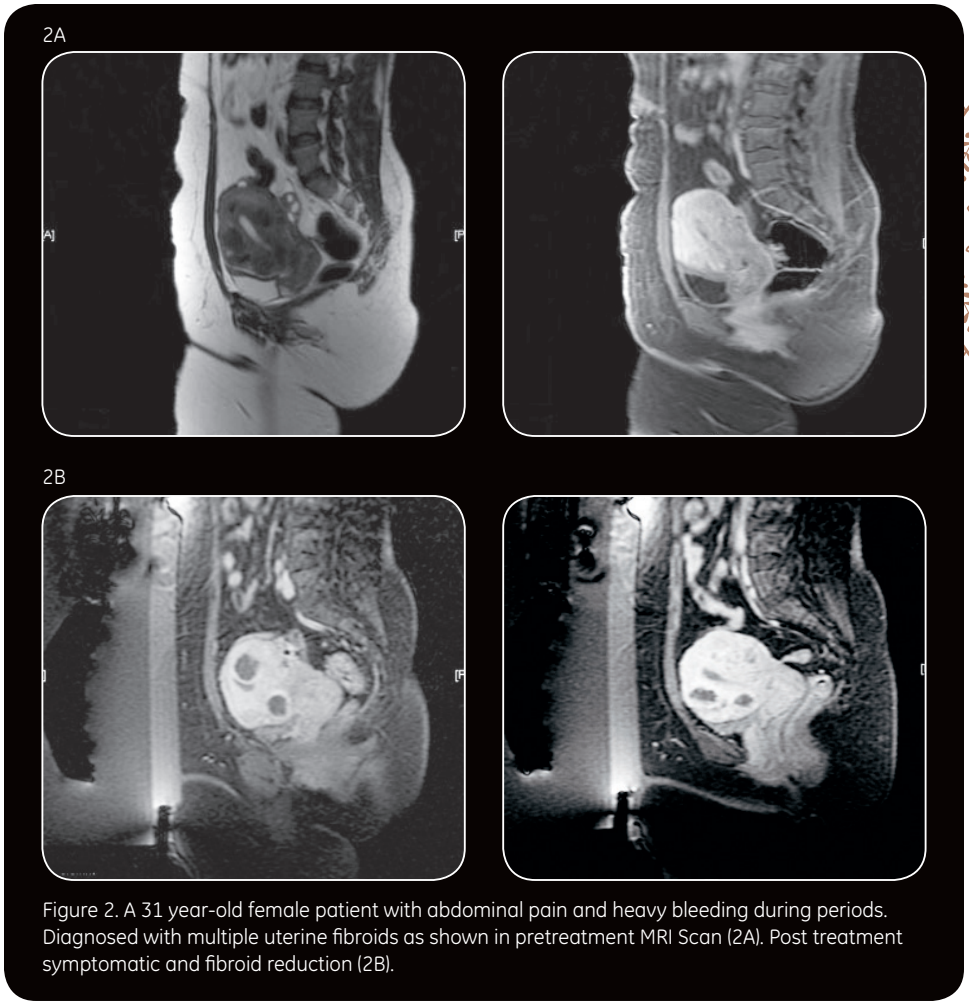


Figure 2. A 31 year-old female patient with abdominal pain and heavy bleeding during periods. Diagnosed with multiple uterine fibroids as shown in pretreatment MRI Scan (2A). Post treatment symptomatic and fibroid reduction (2B).

Shrinivas B. Desai, MBBS, MD

is the Director and Head of the Department of Neuro and Body Imaging, Jaslok Hospital and Research Centre (Mumbai, India).

DIGITAL DIVE

For more information: www.gesignapulse.com/signapulse/signapulseautumn2011#pg71.

For one of the 160 women treated with MRgFUS at Jaslok Hospital, the treatment was a life-changing experience. "The procedure of MRgFUS was surprisingly very comfortable and smooth," she explains. "I had to lie on my stomach on the treatment table for about two to three hours. However, I was awake throughout the 'surgery' and could talk to the nurse and the doctor. I cannot believe that I had a procedure that cured my pain and other symptoms in one day," the patient adds. "I would strongly recommend treatment by MRgFUS to any other woman who is suffering from uterine fibroids."

She notes the recovery was fast and fairly uneventful—there was some burning sensation in the urine. After an overnight stay at the hospital, she went home the very next day and resumed her normal activities the day after.

Dr. Desai is equally impressed with the MRgFUS procedure. "It is a great feeling to perform the procedure—without surgery, any incision or cut, or general anesthesia. Seeing your patient walk away from the treatment table at the end of the MRgFUS procedure is almost akin to a miracle."

"MRgFUS is the technology for the future," says Dr. Desai. "With advancements in technology, applications to treat other pathologies will emerge. I recommend that my radiology colleagues investigate MRgFUS and be on the cusp of this ever-changing technology—the present application of MRgFUS to treat uterine fibroids by itself warrants buying the technology." S

Acknowledgement:

The editor sincerely acknowledges the direction and input of Dhrumil Sorathia, Marketing Manager, at GE Healthcare.

Shrinivas B. Desai, MBBS, MD, *is the Director and Head of the Department of Neuro and Body Imaging, Jaslok Hospital and Research Centre (Mumbai, India). He completed a Fellowship in Imaging & Neuroradiology at Manchester Medical School (UK); a Fellowship in Interventional Neuroradiology at Lariboisier Hospital (Paris, France); and a Fellowship in MRI, Neuroimaging & Interventional Radiology (MGH, Boston). Since 2006, he has been President of the Indian Society of Neuro-Radiology.*

The Jaslok Hospital and Research Centre *is one of the oldest tertiary care, multi-specialty Trust hospitals in India. Jaslok Hospital is a private, full-fledged multi-specialty hospital with 376 beds, of which 67 are ICU beds. The number of consultants has increased from the initial 50 to around 253 with 124 fully trained resident doctors. The hospital conducts research activities in various fields in collaboration with other institutions in India and abroad. Jaslok offers 35 established specialties and attracts a significant number of patients from abroad. Jaslok Hospital also plays an important role in serving the less fortunate sections of the society, which was an important part of the vision of its founders. Out of 376 regular beds, 41 beds in the hospital are offered free of charge and 100 beds are given at concessional rates.*

MR IN A WHOLE NEW LIGHT

An image panel in the ceiling directly over the MR system, developed to augment patient comfort by complementing GE's feet-first MR imaging capability, enables patients to use the iPad to select video or photographs to enjoy—from cheerful cartoons to serene nature scenes.

When it comes to your patients, you strive to deliver the best care possible—including accurate and comfortable MR scanning.

But not all facilities have the capital budgets required for facility additions, the necessary space, or the time for design and construction discussions to add another MR scanner to their diagnostic imaging lineup—or to establish a fixed vs. mobile MR department.

GE Healthcare has collaborated with PDC Facilities (Hartland, Wisc.) to make it easier to provide your patients with the comfortable and technologically advanced MR scanning they deserve.

Additionally, you'll be able to provide GE's uncompromised imaging in a positive environment that reduces anxiety, poor image quality, and time-consuming re-scans.

The spacious, fully finished, custom-built healthcare structure known as the PDC Cassette® is a relocatable diagnostic imaging suite—expressly designed to house a GE MR system. The healthcare-compliant suite is delivered on site within 12 weeks, installed in one day, and patient-ready in three weeks. It's

> "From a patient's perspective, when you enter the MR suite, you don't realize you're in anything other than the hospital."
>
> *Jay Mazurowski, Director of Radiology at Concord Hospital*

ideal for temporary or permanent imaging, saving time and money when compared to fixed-site construction, and provides your patients with cutting-edge MR technology that might have eluded them previously.

Healthcare providers using a PDC Cassette report that many claustrophobic patients are more comfortable in this room and in a wide bore system.

Constraints with money, space, time—no problem

The fixed-price Cassette can help hospitals save considerable time and money in getting new MR services up and running. Capital expenditures typically run 20% to 30% less than new building construction, without the worry of cost overruns or scheduling delays. And because it's a plug-and-play solution, you can provide your patients with cutting-edge GE MR scanning—much faster than with new construction.

"We were in the process of adding a new wing, and we wanted to add a 3.0T Signa* HDxt from GE. We needed the simplest, most expedient construction solution available, and the Cassette suite offered the ideal situation," offers Jay Mazurowski, Director of Radiology at Concord Hospital in Concord, N.H. "It was a very cost-effective solution because we didn't have to worry about competition for resources and project delays."

Space can also be a challenge. In the case of one medical center, the MR unit was originally to be installed in another part of the hospital, adjacent to the radiology department. Unfortunately, the staff discovered this space would encroach upon expansion plans for the emergency department, so a different solution was needed—and quickly. It seemed like every space within the hospital was either spoken for, not compatible with an MR unit, or too far out of the way to easily accommodate patient traffic flow.

The facility started to explore other means of housing an MR, including the Cassette. Because space was a challenge, the fact that the building would be constructed with the specifications of the GE MR system in mind spoke volumes to the site's staff. Also, the methods used to shield the building along with the stringent testing of the shielding told them that this would be a first class purchase.

The University of Wisconsin Hospital and Clinics is another facility that houses one of its GE MR systems in a PDC Cassette. The Discovery* MR750, used mainly for outpatient care, also has dedicated hours for neuro, abdominal, and cardiac research. According to Matt Henry, Radiology Manager with UW Health, the suite's 3.0T system is being used for several exciting "down the road" research projects.

Bringing the human element to MR

The MR Experience™—which can be ordered as part of the Cassette or installed in an existing MR suite—gives patients a unique degree of control over their environment, thereby helping to reduce the anxiety often associated with an MR exam.

"From a patient's perspective, when you enter the MR suite, you don't realize you're in anything other than the hospital," states Mazurowski.

The heart of the MR Experience is the ability to give patients a real voice in their diagnostic surroundings by enabling them to instantaneously change the scan room environment with colorful LED lighting. Before entering the scan room, one touch on an iPad changes the lighting to a custom pallet of the patient's choice. From children to seniors, patients may choose from a range of different lighting schemes—such as soft white, grass green, blue sky, or princess pink. The personalized display illuminates and warms the room in soft tones, making the environment less intimidating.

An image panel in the ceiling directly over the MR system augments patient comfort by complementing GE's feet-first MR imaging capability. Before entering the scan room, patients again have the opportunity to use the iPad to

select video or photographs to enjoy—from cheerful cartoons to serene nature scenes. Photos can be strategically harmonized with music to enhance the selected mood or accompanied by music from the patient's own device. Technologists can create customized welcome messages on the overhead panel and also use it as an educational tool by projecting a life-size, full-body image to help patients understand their MR scan procedure.

Both the Cassette itself and the Experience Cassette™ (a Cassette healthcare building that includes the MR Experience) provide floor-to-ceiling RF glass panels that provide a visual flow from the control room into the exam room. Technologists have a clear, unobstructed view of the patient—and just as importantly, the patient can easily see the staff and be reassured they are in close proximity. This is more comforting for many patients than just a voice on an intercom. Additionally, a built-in seat near the gantry enables a family member or friend to stay with the patient during a scan.

According to healthcare providers employing a PDC Cassette, this environment helps patients relax when they walk into the MR department and are able to see the spacious scan room. They also report that patient volume is rising, and providers seem to have fewer patients who are unable to be scanned due to anxiety issues.

Furthermore, the streamlined control room puts technology comfortably at hand but mostly out of site. With spacious work areas, highly-functional built-in storage, and thoughtfully designed ergonomics, the open workspace helps technologists to perform at their best while feeling right at home—which in turn, puts patients at ease.

"A soothing experience for patients can translate into a more positive outcome—specifically better image quality, and improved productivity for the department. Plus, technologists can now focus their attention where it matters most…on the patient," says Jim Maslowski, Vice President, PDC Facilities, Inc.

To learn about GE's patient-friendly, caring design for the Discovery* MR750w and the Optima* MR450w—the company's 3.0T and 1.5T wide bore systems—visit or touch **www.gesignapulse.com/signapulse/spring2011#pg44.**

"A soothing experience for patients translates into a more positive outcome—specifically better image quality, and improved productivity for the department. Plus, technologists can now focus their attention where it matters most… on the patient."

Jim Maslowski, Vice President, PDC Facilities, Inc

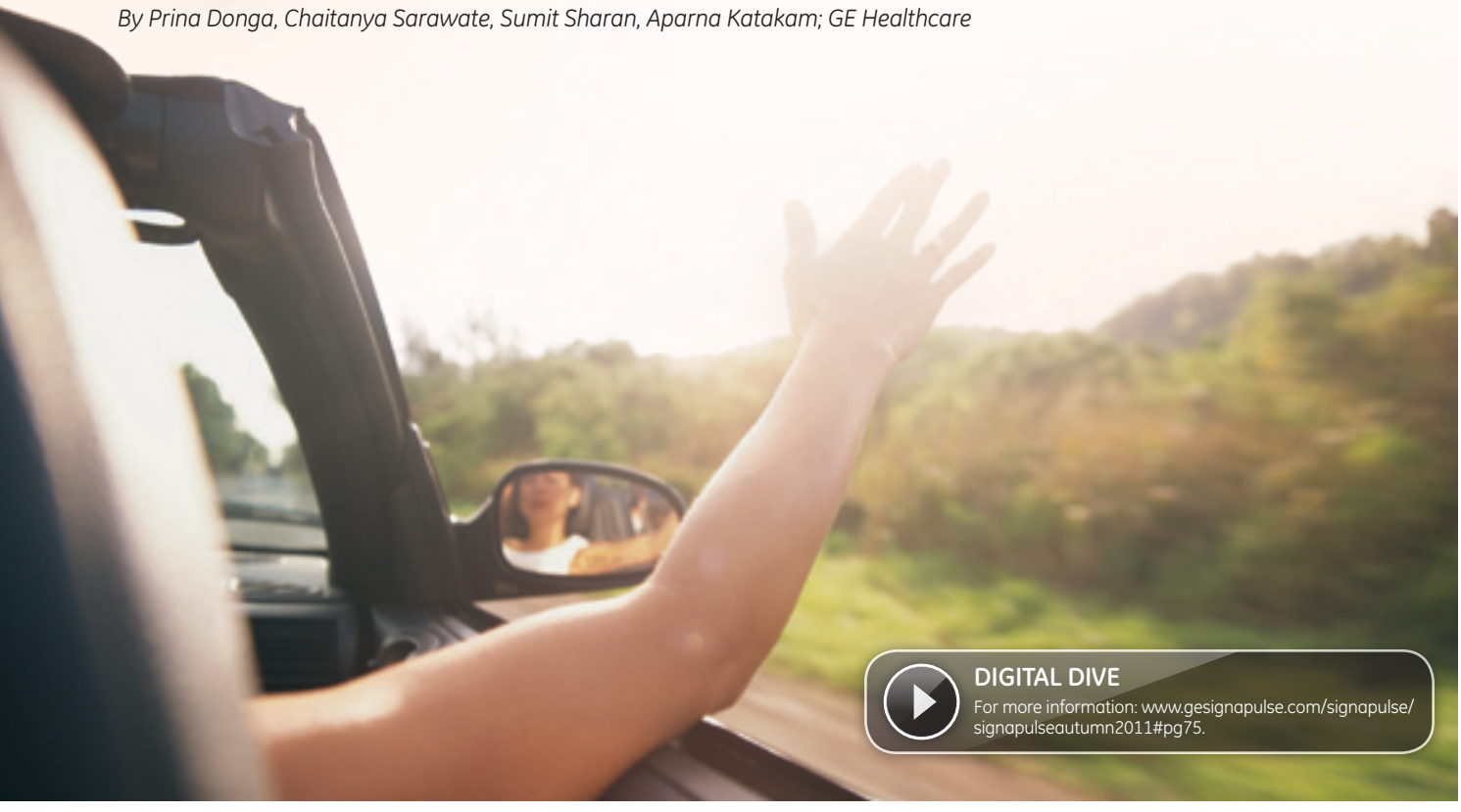
The dramatic advances in imaging technology that have occurred over the last several decades are largely responsible for the accelerated growth across imaging specialties.

Current data suggest that imaging is the most rapidly growing aspect of physician services.[1,2] By 2006, roughly two-thirds of spending on physician imaging services in the US occurred in physician office settings, indicating a shift toward physician offices providing imaging services rather than hospital or other institutional settings.[3] It is now estimated that there are more than 7,000 sites offering MRI in the US, collectively performing more than 26 million procedures annually.[3]

A 2010 hospital radiology census in the United Kingdom (UK) also found the prevalence of imaging equipment increased 38%[4] between 2003 and 2010. Simultaneously, wait times for high-end imaging procedures (e.g., CT and MR) are very long due to unavailability of appointments or low availability of imaging equipment. Between 2002 and 2008 the number of MRI systems in the UK increased by 6% per year but the average wait time for a MRI scan was longer than four weeks.[5] As a result, there is a renewed focus on identifying solutions that will improve hospital and patient workflow productivity in an effort to reduce cost of care while concomitantly helping to improve the care process.

PRACTICE MANAGEMENT: EXTREMITY SCANNERS ENHANCING PATIENT WORKFLOW

By Prina Donga, Chaitanya Sarawate, Sumit Sharan, Aparna Katakam; GE Healthcare



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One such solution may be an extremity MR system, which is a specialized scanner capable of examining distinct, well-defined, three-dimensional (3D) cartilaginous regions of extremities and providing information on morphological variables of interest to clinicians and researchers.[6] Multiple studies in the literature have evaluated various applications of the extremity MR scanner in humans. Results have indicated that an extremity MR scanner is a reliable,[6] time efficient,[7] and robust alternative to the whole-body MR scanner.[8] GE Healthcare sought to assess the effect of adding an extremity MR system to a facility that has a whole-body MR scanner on patient workflow and management at two sites: one in the UK and one in the US.

Adding extremity MR

GE Healthcare, in conjunction with the East Surrey Hospital (Surrey, UK) and Central Magnetic Imaging (CMI) (Miami, Fla.)‡‡, evaluated if the installation of the extremity MR scanner achieved the desired results at both sites.

East Surrey Hospital installed a 1.5T Extremity Scanner in May 2010 to supplement its existing whole-body MR scanner and help enhance patient workflow. "We were not meeting any government targets and had serious capacity issues," says June Milliams, Superintendent Radiographer of East Surrey Hospital.

In January 2011, CMI purchased a GE MSK Extreme* 1.5T MR system to complement the practice's whole-body MR scanner at its CMI South location, primarily due to the pressing need for imaging services. "We were already conducting 678 scans per month, but the demand for MSK and orthopedic imaging from high-profile professional and collegiate athletes was growing," says Michael Thorpe, MD, a musculo-skeletal radiologist and owner of CMI.

Data was collected for a 12-month period from East Surrey Hospital before and after the installation, and for a 12-month period before installation and a five-month period after installation at CMI. The changes in total volume of MR scans performed at the facility and total volume of MR scans outsourced to private centers (East Surrey Hospital), utilization of whole-body and extremity MR scanners, and patient wait times were then compared.

Economic value, patient benefit

Reduced outsourcing

At East Surrey Hospital, scans outsourced to private centers reduced from 14 to four each day while the total volume

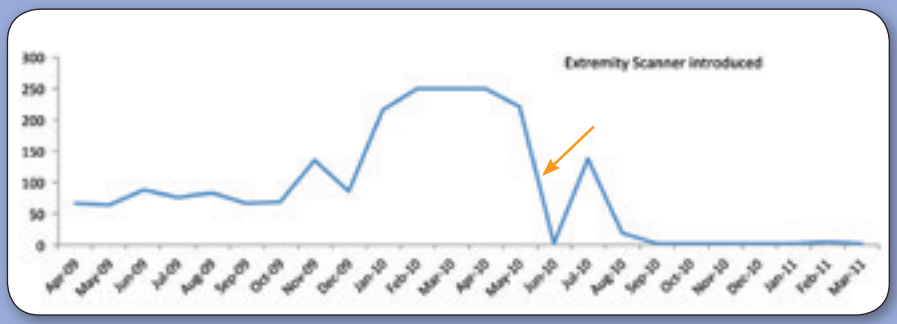

Figure 1. Total scans performed in private centers (East Surrey).

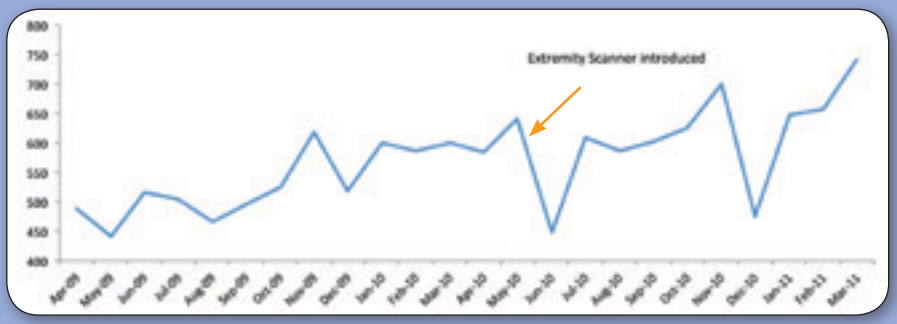

Figure 2. Total scans performed (hospital + private) (East Surrey).

Figure 3. Monthly scans performed (whole-body MRI) (East Surrey).

‡‡Data collection and analysis conducted by Manan Shah, Xcenda (Palm Harbor, FL).

Figure 4. Daily scans performed (whole-body MRI) (East Surrey).

of scans performed increased (534 to 612 each month) after installation of the extremity MR system (Figures 1, 2). Both trends were statistically significant.

Increased throughput

Following the installation of the extremity MR scanner at East Surrey Hospital, monthly scans performed on the whole-body scanner increased significantly (Figure 3) and the type of scans performed on the whole-body MR system were significantly different from pre-extremity MR installation.

The increase in monthly scans on the whole-body scanner is attributed to an increase in the number of working days for whole-body MR from 24 to 28. There was no significant difference in the daily average number of scans performed on the whole-body MR (Figure 4) before and after the extremity MR scanner installation, indicating that the hospital is working at peak capacity with significant unmet demand.

Similarly at CMI, the addition of the extremity scanner led to a 42% increase in the average number of scans—the center now performs more than 950 MR exams each month (Figures 5, 6). Further, the number of patients CMI treats each day has increased from approximately 27 to 40.

While CMI did not employ an expensive or sophisticated marketing technique, it smartly targeted the new extremity scanner to its referral network with note cards. "The increase in patient volumes and scans can be largely attributed to the increase in referrals," notes Dr. Thorpe.

Reduced patient wait time

After the installation of the extremity MR at East Surrey Hospital, the waiting period for extremity scans was reduced by 25%. Since the whole-body scanner is working at peak capacity even after installation of the extremity MR, expectedly there was no significant change in the patient wait time for whole-body scans (Figure 7). Consequently, there is the possibility that if the extremity MR scanner were not installed, there may have been an increase in patient wait times and/or outsourcing.

Milliams says, "GE's extremity scanner is an excellent addition to a whole-body scanner in high patient-volume sites as it can help enhance access and reduce patient wait times."

Another notable observation is that the extremity MRI scanner is underutilized and could be used on incremental scans to further reduce the load on the whole-body scanner (Table 1). Interestingly, the number of extremity scans performed on the whole-body scanner has reduced from average of 69 to 15 each month after the extremity MR installation.

At CMI South, patient backlog dramatically decreased from a 24 to 48 hour waiting period to virtually zero—patients are now scheduled immediately. "The addition of the extremity scanner has helped eliminate backlog and increase patient throughput and patient satisfaction," says Dr. Thorpe.

	Whole-body Scanner	Extremity Scanner
Average working days in a month	28	21
Average scans per day	16	6.6

Table 1. Utilization of extremity scanner (East Surrey).

MR scan details	Relevant reimbursement
One part body/brain	£250.00
Two parts body	£350.00
Three parts body	£450.00
Contrast agent	£75.00

Table 2. Reimbursement of MR scans in UK (2010-2011)[10].

Other benefits of extremity MR

In addition to simplifying hospital workflow—potentially resulting in cost savings—the extremity MR provides specific benefits over whole-body MR scanners in certain applications or patient populations.

- **Image quality:** Dr. Thorpe says CMI uses the extremity scanner exclusively for all scans relating to the upper body due to the overall excellent image quality.
- **Patient experience:** Patients comfortably recline in a padded chair and insert either their lower or upper extremity into the MR bore for imaging. This pays significant dividends when MR scans are performed on claustrophobic patients, obese patients, and children. Parents can accompany their child into the scan room while the child is being examined. "Patients find extremity scans more comfortable for wrist and elbow studies, especially for claustrophobic patients," adds Milliams.

The extremity scanner has a smaller profile and exposure than a whole-body scanner and, therefore, doesn't expose a patient to the same absorption rate of magnetic energy as a whole-body scanner. Patients also benefit from the extremity scanner due to the lower gradient noise levels, a smaller fringe field, and an increase in comfort. "I've received positive feedback from patients regarding the comfort of the extremity scanner," says Dr. Thorpe.

- **Enhanced economics:** Due to lower equipment acquisition and installation costs, and lower variable cost per image,[9] an extremity MR scanner typically has a lower cost of ownership for the provider than a whole-body MR scanner. Concomitantly, the MR image reimbursement depends upon the type of investigation, number of body parts processed under imaging radiology, and use of a contrast agent—but not on the nature of the MR equipment (Table 2). According to Milliams, "The hospital did not have the budget to purchase two, new whole-body scanners. There is reduced costing involved in buying an extremity scanner."

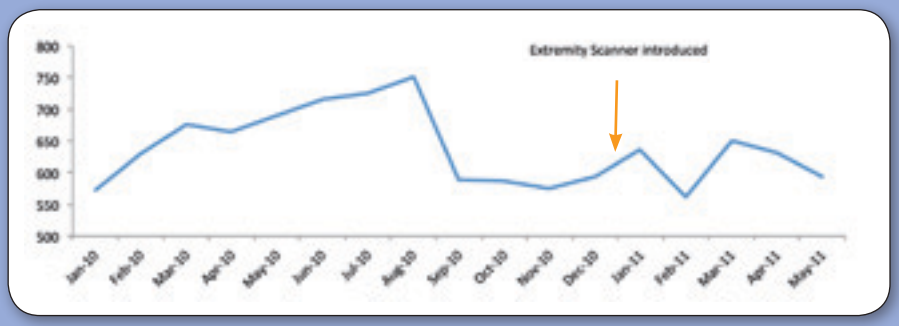

Figure 5. Monthly whole-body MR scans performed (CMI).

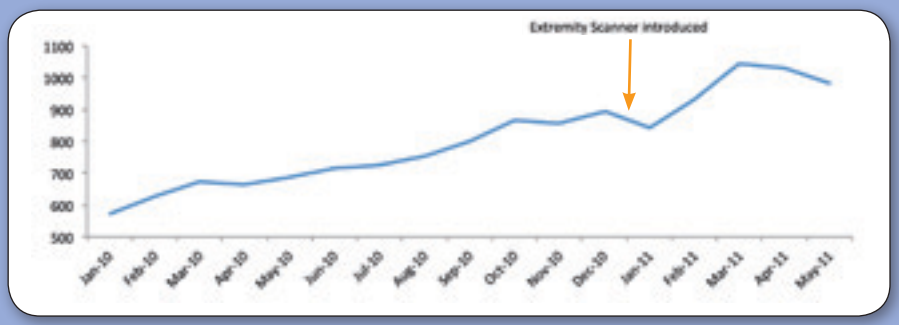

Figure 6. Total scans performed (CMI).

Figure 7. Average wait time (any MRI) (East Surrey).

Conclusion

Due to the current economic climate and the predicted growth of imaging services, extremity scanners have the potential to positively impact providers in a variety of settings. Extremity scanners are beginning to gain national attention for a variety of applications, due to their cost effectiveness and benefits for both the provider and patients.

An extremity MR scanner is an excellent complement to the whole-body MR scanner in applications involving extremities with high image quality, a smaller footprint, and enhanced patient comfort. Based on analyses from two sites, reallocation of extremity exams from whole body to an extremity MR scanner can optimize utilization of MR equipment and increase hospital productivity and patient/technologist convenience.

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Sumit Sharan, Senior Business Analyst.

Aparna Katakam, Global Product Marketing Manager Specialty MR.

Michael Thorpe, MD, *is a nationally-recognized leader in musculoskeletal radiology. Dr. Thorpe, who received his medical degree from the University of Florida, College of Medicine, was a four-year resident at Mt. Sinai Medical center in Miami Beach and a fellow at the Hospital for Special Surgery in New York. Dr. Thorpe has been an owner of CMI for nearly three years.*

CMI South *is accredited by the American College of Radiology, upholding the highest standards in MR testing. Because of the nationally-recognized physicians on staff and the commitment to providing quality care, CMI averages approximately 1000 patients per month and routinely cares for high-profile professional and collegiate athletes including those from the Miami Heat. All exams are interpreted by local board-certified, fellowship-trained physicians.*

East Surrey Hospital *is a district-general hospital in the UK catering to a catchment area with a population of 500,000 and staff strength of 3,000 including more than 75 consultants and physicians. East Surrey Hospital has various diagnostic equipment and uses it in the routine course of delivering clinical care including a whole body MR scanner and an extremity scanner installed in November, 2009.*

TEN TIPS FOR SAFETY PROOFING YOUR MR FACILITY

In celebration of five years of SignaPULSE, Joe Schaefer—Principal Safety Engineer for GE Healthcare and member of the American College of Radiology's Blue Ribbon Panel on MR Safety—offers 10 ways to safety proof your MR facility.

Establishing a culture of awareness, responsibility

What kind of MR safety program is in place at your facility? Is it as safe as possible? Taking a systemic approach to MR safety and establishing a culture of awareness and responsibility at all levels of your organization can help to minimize the likelihood of MR accidents and injuries to patients, operators, and others.

> "In the vast majority of cases, MR scans are performed without incident. Deaths associated with MR scanning are very rare, but accidents and injuries do occur. Flying ferrous objects, elevation of core body temperature to sufficiently high levels, and asphyxiation from quenches have the potential to be life threatening. Facilities need to take these hazards very seriously, and implement measures to prevent them."
>
> *Joe Schaefer—Principal Safety Engineer*

1. Train, train, train.
2. Designate a leader for your MR safety program.
3. Establish policies and procedures.
4. Establish a personnel qualification process.
5. Conduct regular walkthroughs and self audits.
6. Implement the "Zone" concept.
7. Perform proper screening.
8. Limit heating to appropriate levels.
9. Protect against quenching.
10. Establish proper infection control procedures.

Tip One: Train, train, train—at least annually.

"It's crucial that sites train anyone who might have access to the magnet room ... including those who are only occasionally or rarely in the magnetic fields of MR scanners, such as security, housekeeping personnel, firefighters, or police," suggests Schaefer.

Tip Two: Designate a leader for your MR safety program.

This person should have the experience, training and authority to effectively champion all MR safety activities throughout the organization.

Tip Three: Establish policies and procedures to address MR safety.

Clearly documenting the MR safety policies and procedures at your facility can facilitate training, minimize confusion, and help to establish common terminology and work practices.

Tip Four: Establish a personnel qualification process as part of your training program to include new employee indoctrination and recurring training.

Tip Five: Conduct regular walkthroughs and self audits.

Don't get overly comfortable with your MR safety program ... evaluate it on a regular basis and find ways to improve.

Preventing magnetic field accidents

MR has a very safe reputation. However, the powerful combination of magnetic forces and ferromagnetic materials can result in objects flying into the magnet. This is the most common hazard faced by anyone who has access to the magnet room. Not only is it dangerous, it can also cause damage to the magnet—resulting in very expensive consequences.

Tip Six: Implement the "Zone" concept (refer to the ACR Guidance Document for Safe MR Practices 2007) into your MR safety program.

Categorize your zones in whatever way works best for your facility, but as an example, here is how the ACR defines its zones:

Zone I: This region includes all areas that are freely accessible to the general public, typically outside the MR environment itself.

Zone II: This area is the interface between the publicly accessible uncontrolled Zone I and the strictly controlled Zone III. Typically patients are greeted in Zone II and are not free to move at will, but are under the supervision of MR personnel.

Zone III: This area is where free access by unscreened non-MR personnel, ferromagnetic objects or equipment can result in serious injury or death as a result of interactions with the MR scanner. All access to Zone III is to be strictly restricted.

Zone IV: This area is synonymous with the MR scanner magnet room itself. Zone IV will always be located within Zone III as it is the MR magnet and its associated magnetic field which generates the existence of Zone III.

7 Tip Seven: Perform proper screening, and incorporate this into your MR safety program.

Proper screening should include: a thorough patient interview to include disclosure of personal information, a designated "ferrous quarantine" storage area, physical screening for ferromagnetic materials, and a post-screening patient holding area.

Turning up the heat on patient safety

Keeping patients safe and comfortable during magnetic resonance scans is a priority for operators. Unfortunately, during routine scans, patients can get excessively warm and even burned if precautions are not taken.

8 Tip Eight: Limit whole-body and localized heating to appropriate levels, and address heating in your MR safety program.

Here are some specific reminders:

Be sure the magnet room is set at less than 70°F. Operators oftentimes mistakenly think that a warmer room means a more comfortable patient.

Remember that RF can cause localized heating at contact points between the patient/bore, the patient/RF coil and adjacent body parts when a loop is formed (for example, when a patient's hands are touching)—resulting in discomfort or burns. Remember to use pads to space patients from coils, bore walls, and to prevent patient body loops.

Ensure your super cool doesn't become wicked hot

It goes without saying that keeping patients and personnel safe during MR scans is a top priority for all of us. But like it or not, quenching (a sudden boil-off of the entire volume of cryogenic liquid, which causes a rapid loss of the static magnetic field) is a possibility that can lead to serious injury—possibly even asphyxiation.

9 Tip Nine: Protect against quenching by doing the following:

- Keep your exhaust fan system clean.
- Stay current with maintenance services.
- Exclude magnetic items from the magnet area.
- Fill and monitor the helium level regularly before the magnet runs out of helium.
- Follow your scanner's pre-inspection instructions and inspect your system on a regular basis.

Is your MR suite as clean as possible?

We do our best to keep our MR suites in tip-top shape, but are we keeping them—and ourselves—as clean as we should? The importance of properly cleaning the bore, pads, coils, room, and even our hands to cut down on hospital-acquired infections has become a hot topic for administrators and the MR community.

10 Tip Ten: Establish proper infection control procedures

Safety hazards can make it easy to ignore infection control (IC) in MR suites, but the risks make it essential to create a written, detailed plan that includes specific responsibilities and procedures.

According to the OSHA Healthcare Advisor on infection control procedures for MR facilities in hospitals and outpatient centers: develop a written infectious control policy; implement a mandatory hand washing/sanitizing procedure; clean any items that come in contact with the patient, including furniture; inspect pads and replace if frayed, tearing or contaminated; use pillows with a waterproof covering; promptly remove any body fluids; and use extra caution if a patient has an open wound or any history of MRSA or other infection.

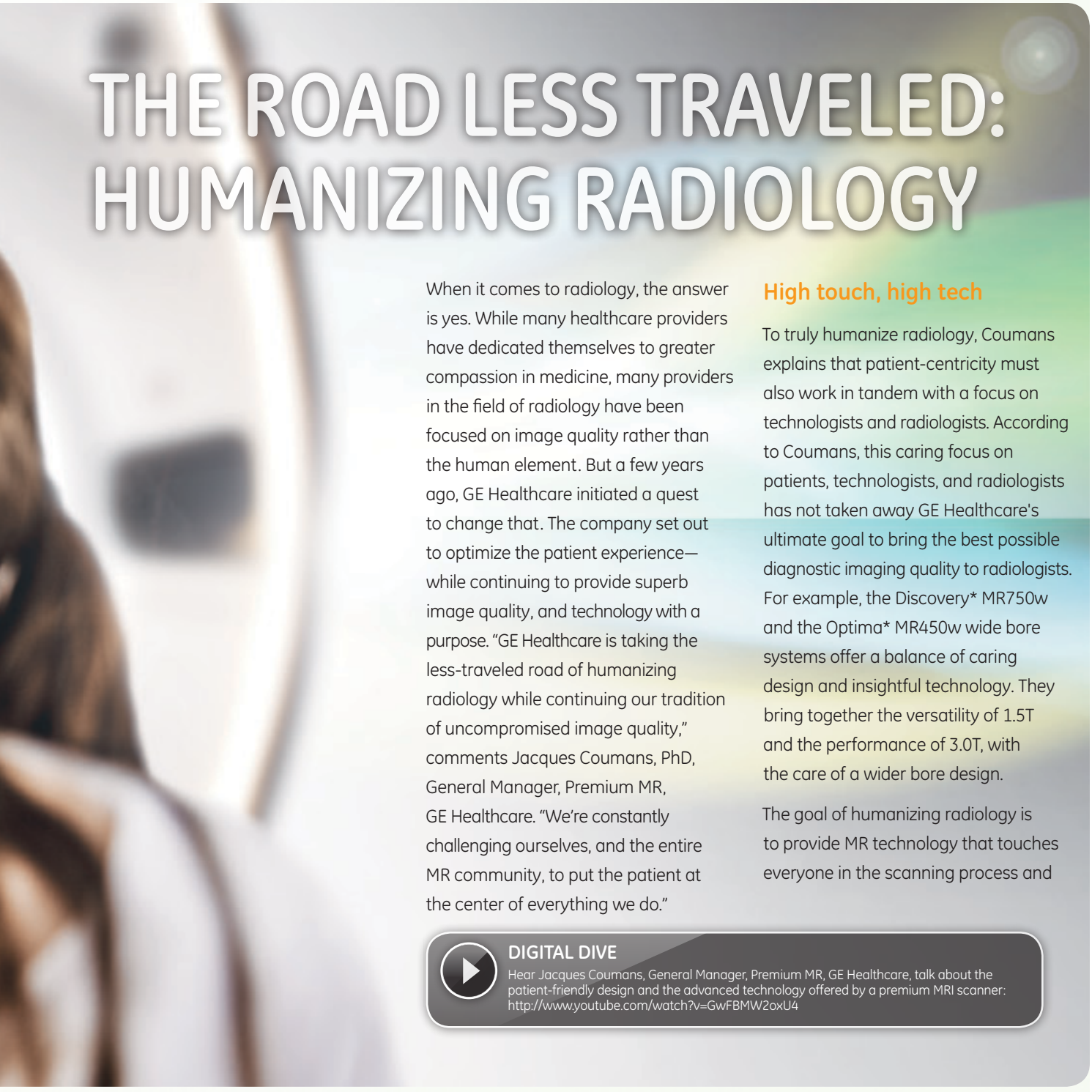
"In the vast majority of cases, MR scans are performed without incident. Deaths associated with MR scanning are very rare, but accidents and injuries do occur," states Schaefer. "Flying ferrous objects, elevation of core body temperature to sufficiently high levels, and asphyxiation from quenches have the potential to be life threatening. Facilities need to take these hazards very seriously, and implement measures to prevent them."

Vitals...

The FDA's Manufacturer and User Facility Device Experience (MAUDE) database documented a total of 40 incidents for MRI in 2004. In 2009, the total more than quadrupled to 193 reported adverse events.

According to Merriam-Webster, the word humanize means, "to represent as human, attribute human qualities to." It can be used in so many ways... to humanize your brand, company, social media, workplace, e-mail address, pets, or healthcare experience. But the big question is, can healthcare technology be humanized?

THE ROAD LESS TRAVELED: HUMANIZING RADIOLOGY



When it comes to radiology, the answer is yes. While many healthcare providers have dedicated themselves to greater compassion in medicine, many providers in the field of radiology have been focused on image quality rather than the human element. But a few years ago, GE Healthcare initiated a quest to change that. The company set out to optimize the patient experience—while continuing to provide superb image quality, and technology with a purpose. "GE Healthcare is taking the less-traveled road of humanizing radiology while continuing our tradition of uncompromised image quality," comments Jacques Coumans, PhD, General Manager, Premium MR, GE Healthcare. "We're constantly challenging ourselves, and the entire MR community, to put the patient at the center of everything we do."

High touch, high tech

To truly humanize radiology, Coumans explains that patient-centricity must also work in tandem with a focus on technologists and radiologists. According to Coumans, this caring focus on patients, technologists, and radiologists has not taken away GE Healthcare's ultimate goal to bring the best possible diagnostic imaging quality to radiologists. For example, the Discovery* MR750w and the Optima* MR450w wide bore systems offer a balance of caring design and insightful technology. They bring together the versatility of 1.5T and the performance of 3.0T, with the care of a wider bore design.

The goal of humanizing radiology is to provide MR technology that touches everyone in the scanning process and

DIGITAL DIVE

Hear Jacques Coumans, General Manager, Premium MR, GE Healthcare, talk about the patient-friendly design and the advanced technology offered by a premium MRI scanner: http://www.youtube.com/watch?v=GwFBMW2oxU4

helps make their lives better. For example, the patient receives a more comfortable scanning experience; the technologist experiences ease of use, speed, and simplicity; the radiologist can count on superb image quality, as well as advanced procedures, exams, and protocols; and the administrator realizes economic sustainability.

Over the last five years, GE Healthcare has introduced technology with a caring purpose—from 10 new systems to innovative new applications—all aimed to create more personal and more satisfying experiences for all involved in the scanning process. See the sidebar directly following this story for a recap of the company's innovation highlights.

Caring design, insightful technology

Among GE Healthcare's many strides in humanizing radiology is the company's introduction of its new wide bore systems. Using the symbol of caring hands as inspiration, the systems were designed to be soothing and welcoming to the patient, and intuitive and user friendly for the technologist. "Our vision is that MR exams should be a safe and comfortable experience for everyone," comments Coumans. "We aspire to a design that makes our MR systems preferred by patients and technologists, without compromise."

Some might question if system aesthetics can really make a difference. According to Jim Davis, Vice President and General Manager of GE Healthcare, it does. "An uncomfortable, moving patient can sometimes lead to poor image quality and time-consuming re-scans," states Davis. "A soothing experience for patients could translate into a more positive outcome for radiologists, including better image quality. Technologists can now focus their attention more on where it matters most—on the patient."

> "Strong collaborations push us to advance the MR industry. We salute those who apply their uncompromising vision to advancing and humanizing MR. Just as their work revolutionizes science today, so will it touch lives tomorrow."
>
> *Jim Davis, Vice President and General Manager, GE Healthcare*

For more information about the caring design, visit **www.gesignapulse.com/signapulse/spring2011#pg44.**

Shining stars

A view of GE's quest to humanize radiology wouldn't be complete without a look back at the company's key collaborations and advancements in MR. These key developments have all contributed to optimizing the human element in radiology.

"Strong collaborations push us to advance the MR industry," explains Davis. "We salute those who apply their uncompromising vision to advancing and humanizing MR. Just as their work revolutionizes science today, so will it touch lives tomorrow."

Key collaborations have been an integral part of cutting-edge innovations from GE Healthcare. These have aided the company in bringing many products to market that have improved patient-centricity in MR, such as:

3D ASL—David Alsop, PhD, Beth Israel Deaconess Medical Center. Advanced NCE technique for quantifying blood perfusion in the brain that is 3D FSE based and uses pulsed continuous (aka pseudo continuous) arterial spin labeling method.

IDEAL IQ—Scott B. Reeder, MD, PhD, University of Wisconsin. IDEAL IQ is a promising MR-based technique that provides volumetric whole-liver coverage in a single breath-hold and generates estimated T2* and fat fraction maps in a non-invasive manner. To review clinical cases that demonstrate the potential clinical utility of IDEAL IQ including examples of its role in diagnosis and therapy monitoring, and how it could be used in conjunction with the MR Touch application for assessment of diffuse liver disease, visit **www.gesignapulse.com/signapulse/spring2011#pg75**

PROPELLER—Jim Pipe, PhD, Barrows Neurological Institute. The first commercial MR method to eliminate blurring in a scan due to patient movement—a method now available on most commercial scanners.

New heights

Using the past as a guide and incorporating many existing MR innovations, GE Healthcare continues to work with its research collaborators to bring more products to market that will elevate radiology's human element further. This year, GE Healthcare is

introducing several new innovations that will benefit the patient, technologist, radiologist, and administrator.

GEM-enabled workflow—With the redesign of the Optima MR450w, and the addition of the Geometry Embracing Method (GEM) Suite, GE Healthcare has committed to a focus on the human element. In that vein, GEM-enabled workflow gives equal priority to patient, technologist, and radiologist needs. For more information, see pages 60–63.

MultiDrive RF Transmit—The leap in image quality from 1.5T to 3.0T is unquestionable, yet as MR technology improves, new challenges continue to present themselves. For example, shading artifacts are more challenging at 3.0T than 1.5T, particularly with abdominal scans. Wide bore MR systems further complicate this issue, since at 70 cm the space between the RF coil and RF shield diminishes, requiring more precise control over the RF transmit system. To help solve this issue and unleash the power of 3.0T on the Discovery MR750w, GE Healthcare introduces the MultiDrive RF system, an independent RF pulse control, and a new whole-body, 4-port drive RF coil design. Together, these innovations improve signal uniformity across the FOV regardless of patient size. For more information, see pages 66–67.

MR Experience—GE Healthcare's MR business collaborated with PDC Facilities to provide the MR Experience™ in a PDC Experience Cassette™—a relocatable diagnostic imaging suite, expressly designed to house a GE MR system. The MR Experience gives patients a unique degree of control over their environment, helping reduce the anxiety often associated with an MR exam to help minimize patient movement and decrease retakes.

The heart of the MR Experience gives patients a real voice in their diagnostic surroundings by enabling them to instantaneously change the scan room environment. One touch on a tablet changes the video screen over the exam table, as well as the LED room lighting to the patient's choice from a variety of different color schemes. Along with familiar photos or videos on the overhead screen, the colored lights warm the room in soft tones, making the environment less intimidating. For more information, see pages 72–74.

Will there be greater advancements in humanizing radiology in the future? According to Coumans, where GE Healthcare has been drives where the company is going—and there's still a lot left to do in the effort to humanize radiology. "Our new, caring direction, combined with uncompromised technology and image quality, should influence the next generation of products for years to come," he offers.

More to come

And will GE Healthcare stop there? Davis is confident there are more technology advances to come, such as metabolic imaging with hyperpolarized Carbon 13‡‡(C13). GE Healthcare recently announced that it is dedicating $1 billion of its total R&D budget over the next five years to expand its advanced cancer diagnostic and molecular imaging capabilities, as well as its world-class technologies for the manufacture of biopharmaceuticals and cancer research. The company is a leader in diagnostic imaging for the detection of cancer and is a leading provider of technologies for cancer research and biopharmaceutical manufacturing.

In MR, this reinforces our focus on the development of technologies such as metabolic imaging with hyperpolarized C13 for research and biopharm manufacturing activities. For more information, see pages 64–65.

"None of us can move the needle in MRI alone... it takes a team bigger than any of us as individuals to come together and make smart decisions to push the boundaries of MR," says Davis. GE Healthcare intends to continue its quest when it comes to humanizing radiology.

Acknowledgement:

The editor sincerely acknowledges the direction and input of Jason Polzin, PhD, Chief Engineer, MR Software and Applications, GE Healthcare, Global, in crafting this article.

‡‡CAUTION: Sterile compounding equipment. Output of this equipment may only be used for human applications under an approved research study (IND or equivalent).

TECHNOLOGY WITH A CARING PURPOSE

Over the last five years, MR has been seen in a new light, thanks to these GE innovations that are patient-conscious, offering a caring focus and design.

- Advances in MR imaging, including 3.0T SAR management, new approaches in cardiac imaging, applications designed to help improve breast diagnosis, and solutions for producing high-resolution MR images despite patient movement.
- The introduction of the Signa* HD product family and a comprehensive breadth of powerful clinical applications: PROPELLER HD for high-quality brain imaging overcoming motion artifacts; MR Echo for real-time heart imaging without breath holding or ECG gating; VIBRANT for bilateral breast imaging in a single exam; TRICKS for MR angiography of the legs; and LAVA for making outstanding abdominal MR imaging easier.
- The unveiling of MR-guided focused ultrasound from InSightec®, on the GE Signa* HDxt 1.5T, enabling non-invasive MR-guided treatment of uterine fibroids with thermal ablation.
- Breast MR technology, including VIBRANT and VIBRANT-XV; BREASE—an easy-to-use, breast-specific, single-voxel spectroscopy tool for lesion characterization and assessment of early treatment response; and the HD 8-channel Breast Array—exceptional SNR for high image resolution and excellent access for intervention.
- The next dimension in HD MR imaging, the Signa HDxt, and innovative applications that radiologists could put to immediate use on the new system:
  - IDEAL—consistent, exceptional fat suppression for even the most challenging anatomies, addressing the problem with metal and chemical shift artifacts;
  - Cube—the 3D, HD acquisition that allows viewing in any plane, eliminating operator variances and minimizing blurring to acquire complete data from scan—all while significantly reducing total exam time by at least one-third;
  - LAVA Flex—abdominal imaging with four contrasts in one breath-hold, in-phase, out-phase, fat, and water images;
  - ARC—a major step forward in speed and accuracy, delivers a highly accelerated parallel imaging technique, enabling tight FOV prescriptions; and
  - BrainSTAT—provides an effective way to visualize the effects of neurological conditions, providing valuable treatment information quickly
- The Discovery* MR750, a powerful 3.0T system offering greater coverage, higher resolution and significant improvement in uniformity and accelerated acquisition and reconstruction speed, a reduction of set-up time up to 70% over fixed-table designs, plus a high-resolution in-room display (compared to previous systems).
- Exceptional clinical images were released from the Discovery MR750, Discovery* MR450, MR Touch, and Signa* HDe—the first "green" ecomagination product. Plus, more options for non-contrast imaging were added, such as the Inhance Applications Suite, and the company introduced SWAN—a fast, easy, mutli-echo acquisition technique to help clinicians diagnose patients with ischemic and cerebral disease.
- The introduction of the Optima MR450w wide bore system, which overcame a 40% loss in efficiency resulting from moving from 60 cm to a 70 cm diameter patient bore while maintaining excellent image quality.
- The announcement of MR Touch—an important diagnostic test in assessing patients with suspected liver disease to detect the presence of hepatic fibrosis, which can often be treated if diagnosed early enough before it progresses to irreversible cirrhosis. This innovation arose from the company's collaboration with Dr. Richard Ehman at Mayo Clinic.
- The company expanded into the extremity-specific arena by purchasing certain assets of ONI Medical Systems. The Optima* MR430s, based on technology and comfort offered on the ONI MSK Extreme 1.5T, was then unveiled.
- Two new systems were introduced—both using the same proven magnet as the Discovery MR450. Designed for customers needing strong performance, versatility, and outstanding value without compromise, the Optima* MR360 delivers a broad range of advanced software applications, new RF technology enhancements, workflow automation features, and low overall cost of ownership. The comprehensive, affordable, and intuitive Brivo* MR355 was intended for the first-time MR institution—aiming to bring high-field MR within reach to a vast array of hospitals.
- GE Healthcare received FDA clearance of READY View, a new MR advanced visualization platform to help clinicians process and analyze images anytime and anywhere.
- The introduction of the Geometry Embracing Method (GEM) Suite of Flex coils, used in imaging all joints—replacing the hard, plastic coils with embracing, flexible ones—and offering a way to more comfortably image any joint.

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BLOWING THE WHISTLE ON BLOWS TO THE BRAIN

Let's take a little quiz: Of all reported injuries, intercollegiate athletes from which sport reported the highest percentage of concussions during a game?

- Women's soccer
- Football
- Women's lacrosse
- Men's ice hockey

If you said football, you'd be wrong—it's actually women's lacrosse. Surprisingly to many, these players reported the highest concussion incidence at 13.9%.[1] "As a society, we have a misconception about who's going to sustain concussion," says Dr. Bill Moreau, United States Olympic Committee (USOC) Director of Sports Medicine Clinics. "And sadly, in the US alone, millions of athletes are not represented in epidemiological concussion studies."

The jolting truth

A concussion is a type of mild traumatic brain injury, or TBI, and all are serious. The reality is harsh: A 2006 CDC report estimated that TBI is more prevalent in the US than breast cancer, HIV/AIDS, multiple sclerosis, and spinal cord

injuries. Additionally, each year nationwide, an estimated 1.7 million people sustain a TBI; of them, 52,000 die.[2]

According to a Boston University study, a growing body of evidence suggests that repetitive head trauma may increase the risk of a variety of progressive brain disorders, including Alzheimer's, Parkinson's, and the muscle-wasting condition amyotrophic lateral sclerosis—otherwise known as ALS or Lou Gehrig's disease.

Olympic sport

In addition to college- and pro-level concussion risks, some Olympic-level athletes have a high risk as well. Based on a 2010 National Team Camp in Colorado Springs, Colo., synchronized swimmers had a 50% concussion rate (per USOC unpublished data).

Furthermore, a USOC study of a small group of elite-level female wrestlers showed that 77.8% suffered headaches, and 66.7% experienced dizziness (both symptoms of concussion). Per Sport Concussion Assessment Tool (SCAT2), a standardized method of evaluating injured athletes for concussion, Olympic-level wrestling has a 43% concussion incidence.

> "As a society, we have a misconception about who's going to sustain concussion."
>
> *Dr. Bill Moreau, United States Olympic Committee (USOC) Director of Sports Medicine Clinics*

The long-term impact of collisions in sports has become a hot-button issue with the National Football League (NFL). As of the writing of this article, the NFL announced plans for a broader concussion study—for more information, visit or touch **www.tiny.cc/jf8fp.** The NFL has gone to unprecedented lengths to control the violent collisions that result in concussions. But actually, football ranks lower in concussion incidence than four intercollegiate sports. Here's the breakdown:[1]

- Women's lacrosse (13.9%)
- Women's soccer (11.4%)
- Men's ice hockey (10.3%)
- Men's lacrosse (10.1%)
- Football (8.8%)

Pinpointing youngsters, women

Young athletes are of special concern because their brains are still developing. The effects of a concussion—or even many smaller hits over a season—can be far more detrimental, compared to head injury in an older player.

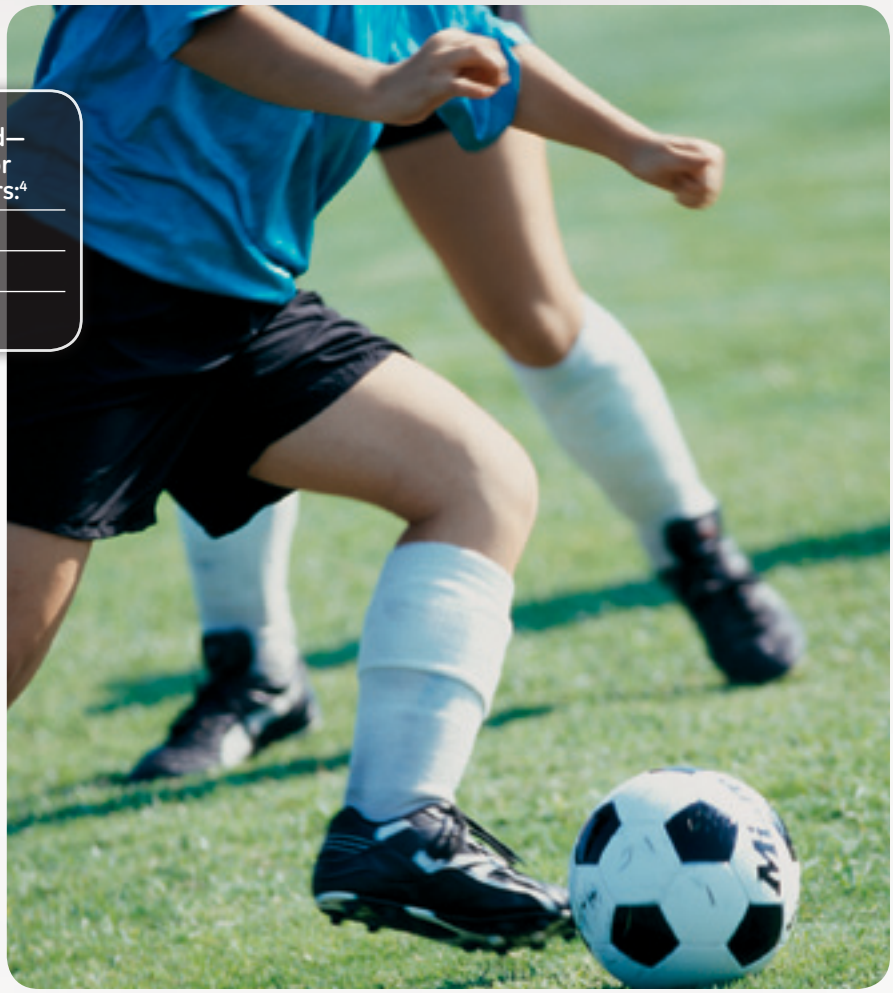
The Concussion Clinic at Nationwide Children's Hospital in Ohio estimates 400,000 concussions occurred among 7.5 million student athletes who participated in high school sports during the 2008–2009 school year. Furthermore, a recent clinical study by the Children's National Medical Center in Washington D.C., found that more than 80% of student athletes who experienced concussions reported a significant worsening of symptoms over the first four weeks after attempting to return to school academics.

Concussions are not all about football, and they are also not all about males. Interestingly to many, females have a higher concussion rate than males. Consider these statistics:

NCAA data over 16-year period:[3]	
Women's soccer	5.3%
Men's soccer	3.9%
Women's basketball	4.7%
Men's basketball	3.2%

> "When head injuries occur, GE Healthcare wants to help doctors, patients, and parents feel confident about the best treatment option. We feel that starts with longitudinal studies."
>
> *Jonathan A. Murray, GM Metabolic Imaging, GE Healthcare*

High School data over 11-year period—female athletes at a greater risk for concussion compared to male players:[4]	
Soccer	2.1 times greater risk
Softball	1.9 times greater risk
Basketball	1.7 times greater risk



Why are the rates higher for women? Dr. Tracey Covassin, Associate Professor, Undergraduate Athletic Training Program Director at Michigan State University, attributes it to several factors. Females have 50% less isometric neck strength, 23% less neck girth, 43% less head-neck segment, and 50% greater head-neck peak angular acceleration (Tierney et al. 2005). Additionally, researchers have suggested that female soccer players have a larger ball-to-head size ratio than males, possibly predisposing them to concussion.

Furthermore, male athletes are oftentimes praised for their courage and rewarded when playing through pain and injury. In contrast, studies have found that female athletes are more concerned about their future health than males. Thus, women are more likely to report their concussions.

"Epidemiological studies identifying concussion rates in sports, both for women and men, are a critical component of ongoing research," comments Dr. Covassin.

Collaboration: furthering insight from tragedy

Oftentimes, doctors do not examine athletes until after they are injured—having no idea what is normal for them. As a leader in MRI, and a believer in prevention, GE Healthcare collaborated with Purdue University to establish a platform to provide longitudinal data from "healthy through insult and recovery" on a high school football team. The study was largely funded by the Indiana Spinal Cord and Brain Injury Research Board.

"There is a lack of knowledge in the diagnosis and treatment of brain injuries. To better understand brain injury and optimize recovery methods is critical," comments Jonathan A. Murray, GM Metabolic Imaging at GE Healthcare. "When head injuries occur, GE Healthcare wants to help doctors, patients, and parents feel confident about the best treatment option. We feel that starts with longitudinal studies."

> "In 50 percent of the players who were brought in 'not concussed,' we detected changes—either in their computer-based testing and/or in their functional MRI data, showing that something had changed in the way their brain was performing a particular set of simple tasks."
>
> *Tom Talavage, associate professor at the Weldon School of Biomedical Engineering, Purdue University,*

Developed at Purdue University with Jefferson High School (Lafayette, Ind.), the ongoing study is advancing the understanding of concussions by providing a non-invasive, in vivo method to study these injuries. It is an important step in improving knowledge of brain injuries and should lead to improved return to play and life, better therapies, and better guidance to protective equipment design and proper play techniques.

"Studying the brain is difficult," says Murray. "We rarely know how the brain performed before the injury because typically, studies take place after an injury or tragedy—making it challenging to get a baseline to use as comparison."

Tom Talavage, associate professor at the Weldon School of Biomedical Engineering at Purdue University, and co-director of Purdue University's MRI facility, is an expert in functional neuroimaging. He has been conducting the study, which focused its first year on collisions to the head in 21 high school football players (Talavage et al., inpress). The study has now monitored more than 50 players during the past three years. "We were looking to understand what kinds of hits cause a concussion and what the consequences are," he offers.

There were four stages to the study: baseline assessment, in-game monitoring, in-season follow up, and post-participation follow up. Before the season started, to establish a baseline, the players were given a computerized neurocognitive exam that tests memory and concentration—and tests of working memory while their brains were monitored with MRI and functional MRI (fMRI) using the Signa* HDxt 3.0T from GE Healthcare.

All hits to the head exceeding 14.4 Gs were recorded—using monitoring equipment called accelerometers, placed inside the helmets—throughout the season. Based on the number or the magnitude of hits to the head they had experienced, 11 of the 21 players participating in the first season were invited back for additional tests during the season. Ten of these 11 players then underwent a post-season assessment several weeks after the end of the football schedule. Information obtained during and after the season could then be examined against the established baseline for each player.

This is the first study to combine MRI, fMRI, biomechanical monitoring, and cognitive testing at multiple times before, during, and after the season to evaluate the effects of hits to the head—including those not leading to a concussion. The results were stunning. "In 50 percent of the players who were brought in 'not concussed,' we detected changes—either in their computer-based testing and/or in their functional MRI data, showing that something had changed in the way their brain was performing a particular set of simple tasks," explains Talavage.

The study shines a light on injuries that have a potential to be more treacherous than full-blown, "clock cleaning" concussions because they don't always result in outward symptoms—leading to players continuing participation. The concern is that these injuries could add up to cause serious, long-term cognitive problems. "Our key finding is a previously undiscovered category of cognitive impairment," comments Talavage.

DIGITAL DIVE
For more information on the NFL concussion study: www.tiny.cc/jf8fp

DIGITAL DIVE
For more information: www.tiny.cc/zlwq3

Another pioneering GE Healthcare collaborator is San Francisco General Hospital—the first nationwide to gain certification for the treatment of TBI. It received certification after an intensive on-site visit by the Joint Commission, a national independent organization that accredits hospitals and offers disease-specific certifications. The majority of the hospital's imaging equipment is GE Healthcare equipment, including two Signa* HDxt 1.5T MR scanners.

While it's impossible to stop concussions from occurring, collaborators such as these can help determine, "What is normal for you?" and "What kind of concussion do you have?" With a healthy baseline to which the injury can be compared, the best diagnosis and treatment can be selected.

A first down on diagnosis

According to Murray, one of the most challenging aspects of treating concussions is diagnosing the part of the brain that has been damaged. "As we learn more, MRI will have an even bigger role in diagnosing brain damage," he says. GE Healthcare is taking an important step by researching a head-only MRI scanner.

GE Global Research, the technology development arm for GE, and Mayo Clinic, have received a five-year, $5.7 million grant from the National Institute of Biomedical Imaging and Bioengineering, and the National Institute of Neurological Disorders and Stroke—components of the National Institutes of Health. They will jointly conduct research to understand design and application issues involved in the use of a dedicated MRI brain scanner‡‡ to image for a range of neurological and psychiatric disorders such as TBI, stroke, Alzheimer's Disease, Parkinson's Disease, depression, and autism.

"A head-only MR system would make neurological and psychiatric examinations of all age groups so much easier. Patient access and management will be enhanced without compromising image quality or scanner performance," says Thomas K. Foo, Chief Scientist, Diagnostic and Biomedical Technologies at GE Global Research. For more information, visit or touch **www.tiny.cc/zlwq3.**

The next play

Now in its third year, the Purdue study includes a second football team, as well as a girls high school soccer team—providing better insight as to how a lack of head protection impacts the rate of concussion. Talavage is also studying students playing sports that are considered to be non contact, such as track and volleyball.

Talavage says the Jefferson High football players should be considered "heroes," as they have graciously volunteered their time to help further the groundbreaking study and prevention of concussions. Several of the players moved on to college, but they have agreed to return for a study on how their first college football season compares to high school.

Additionally, there is a movement supporting "coaching to play differently"—especially at the high school level and below. According to Dr. Larry Leverenz, interim department head of Health and Kinesiology at Purdue, football coaches across the country are being encouraged to take a hard look at changing their techniques to reduce blows to the brain. For example, many are watching films to determine how tackling and blocking drills could be run differently (or stopped), and some are stopping full-contact practices or enforcing hit limits.

Could better football helmets reduce the impact of head blows? Researchers are working on this with helmet designers.

> "A head-only MR system will make neurological and psychiatric examinations of all age groups so much easier. Patient access and management will be enhanced without compromising image quality or scanner performance"
>
> *Thomas K. Foo, Chief Scientist, Diagnostic and Biomedical Technologies, GE Global Research*

Vitals...

- TBI is a contributing factor to a third (30.5%) of all injury-related deaths in the United States[1] (and about 75% of TBIs that occur each year are concussions or other forms of mild TBIs).
- Annually, US emergency departments treat an estimated 135,000 sports- and recreation-related traumatic brain injuries, including concussions, among children ages five to 18 (CDC).
- 235,000 people are hospitalized annually as a result of brain injury (CDC).
- A brain injury occurs every 23 seconds in the US (BIA-USA, 2006).
- TBI is more prevalent in the US than breast cancer, HIV/AIDS, multiple sclerosis, and spinal cord injuries (CDC, 2006).
- Currently, 5.3 million Americans are living with disabilities resulting from TBI, and 80,000–90,000 join their ranks each year (CDC).
- Brain injury is the leading cause of death and disability for people between the ages of 15 and 24 (CDC).
- The cost of TBI in the US is estimated to be $60 billion each year (CDC).

"Football players are bigger, stronger, and faster than ever. It's simple physics... there's more force running toward each other. We need to figure out how to get these athletes better helmet protection," offers Leverenz.

Despite advancements in helmet protection, Talavage cautions there is no such thing as a concussion-proof helmet—and he says it's unclear whether helmets reduce the energy force being delivered to the brain... some of the data collected by the Purdue Neurotrauma Group suggests they may be amplifying it.

"With technology making helmets stiffer, harder, and more protective against skull fracture, football players are using them as a 'tactical weapon'—and when an athlete uses his helmet to hit and tackle another player, he may be causing damage to his own brain," comments Talavage.

According to Dr. Covassin, the NCAA and CDC are encouraging players to report concussions to a teammate, family member, athletic trainer, coach, etc. Both organizations offer fact sheets and videos that promote concussion safety and return to play. "All consensus statements on concussion advocate for NOT returning any athlete who has a concussion on the same day as his/her concussion. They also advocate for a step-wise return to play progression," she says.

The recommended return-to-play step wise process following a concussion includes:

- No activity, complete rest until asymptomatic;
- Light aerobic exercise such as walking or stationary cycling, no resistance training;
- Sport-specific exercise and progressive addition of resistance training;
- Non-contact training drills;
- Full-contact training after medical clearance;
- Game play (McCrory et al. 2009).[6]

Unfortunately, says Dr. Moreau, concussion rates are not available for many low-impact Olympic sports, such as softball, fencing and rowing. While there are many deficiencies in the studies that do exist, there is good news: The study of the management of concussion evaluation and management is in transition.

‡‡ Technology in development that represents ongoing research and development efforts. These technologies are not products and may never become products. Not for sale. Not cleared or approved by the FDA for commercial availability.

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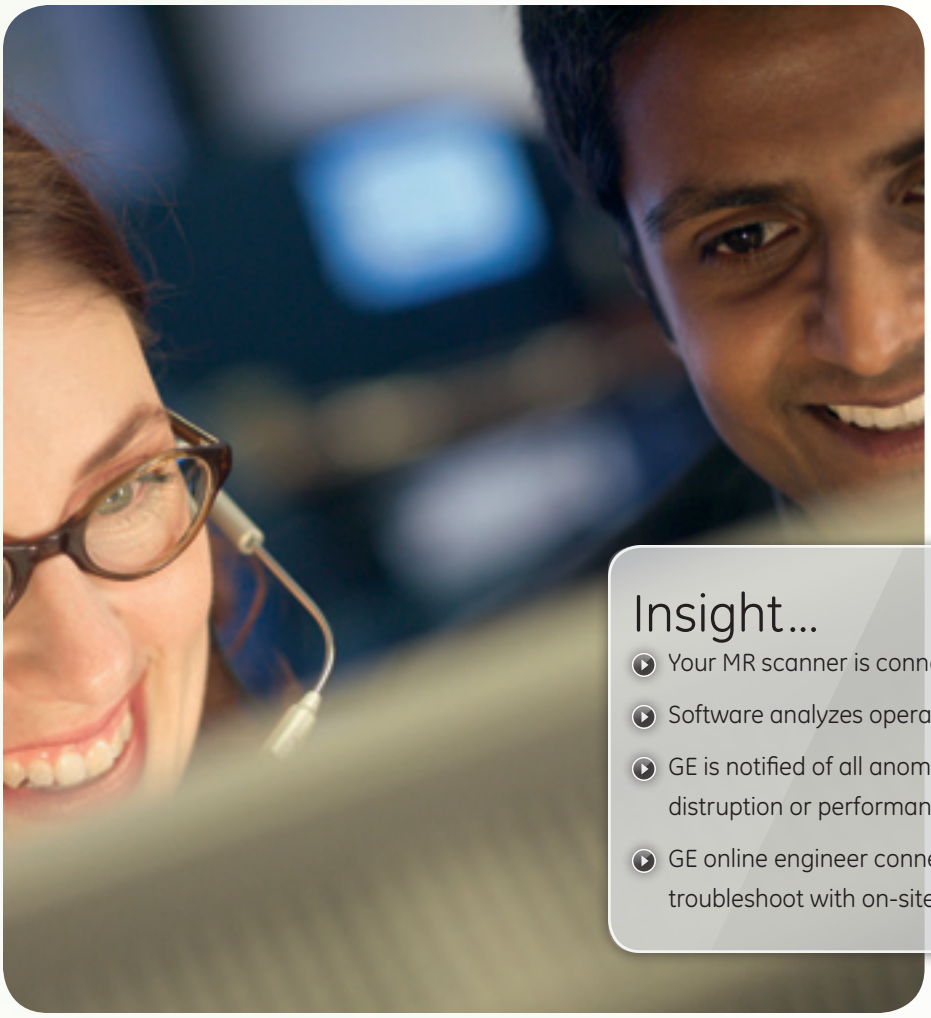
Operating an MR scanner at peak performance—without unplanned downtime—is a critical factor for achieving a return-on-investment. And for many imaging sites with one scanner, any unexpected service event translates to turning away patients—and revenue.

BENEFITS OF PROACTIVE MONITORING



Insight…

- Your MR scanner is connected to the GE online center.
- Software analyzes operational data from your scanner daily.
- GE is notified of all anomalies signaling an impending system distruption or performance issue.
- GE online engineer connects to your system remotely to troubleshoot with on-site diagnostic follow-up.

Fortunately for GE customers, InSite* OnWatch facilitates technical problems prediction—such as coil failures, chiller issues, or environmental conditions—to keep Signa* HDxt and more advanced scanners running at optimum performance.

The service allows GE engineers to remotely conduct inspections of key system components and performance indicators prior to scheduled onsite preventive maintenance events. The analytics are performed in the back-ground without any interruption to workflow.

Here's how it works. Several times per day, sophisticated software analyzes operations data sent from an MR scanner connected to the GE online center. If InSite OnWatch detects anomalies that may signal an impending system disruption or performance issue, it automatically notifies a GE online engineer. The GE online engineer remotely connects to the system, performs troubleshooting procedures, and contacts the site to explain the issue.

This was the case at Swedish First Hill Hospital in Seattle, Wash. A 1.5T Signa* HD MR scanner handles the entire patient load with inpatients, outpatients, and emergency cases accounting for up to 300 exams per month, says Terry Austad, Lead MRI Technologist.

In October 2010, the staff began to experience a fault that limited use of the 16-channel head, neck, and spine (HNS) array coil. The fault, which was intermittent and thus very difficult to diagnose, increased in frequency over time. This problem was particularly troublesome because Austad and his team perform complete neurological exams without having to reposition the patient using the HNS coil.

> "I am impressed with OnWatch. It's a good service, and it's comforting to know that the GE engineers have this type of tool to diagnose and solve our service issues."
>
> *Terry Austad, Lead MRI Technologist*

"At times, the MR scanner did not recognize the coil," Austad recalls. "As a consequence, we were unable to use that coil and had to substitute older 4-channel coils." For combination brain and spine studies, the staff had to use separate coils and perform two exams. This required moving the patient and switching coils to finish the entire study. "The physicians still got their studies, but the exams took longer and disrupted our schedule," he adds.

Online proactive monitoring through InSite OnWatch indicated a problem with the cable connecting the coil to the MR scanner. The GE field engineer used this information to isolate the defective part that was causing the coil connection problem, notified Austad, and replaced the cable the next day. That resolved the issue.

"I am impressed with OnWatch," Austad says. "It's a good service, and it's comforting to know that the GE engineers have this type of tool to diagnose and solve our service issues."

GE's proactive monitoring service can also help sustain image quality and minimize the risk of unplanned downtime. At North Valley Advanced Imaging, a busy outpatient imaging center in Chico, Calif., with two 1.5T GE MR scanners serving 30 to 36 patients per day, "any disruption in patient flow would be disastrous," says Jerry Molnar, Senior Staff MRI Technologist. As part of North State Radiology, a provider of radiology services to many regional hospitals, North Valley insists on the highest-quality diagnostic images to help ensure each patient receives excellent care.

GE engineers using InSite OnWatch detected an anomaly in North Valley's shoulder coil and notified Molnar. "We performed a shoulder scan with our old coil and then another scan with a new coil the field engineer brought," Molnar recalls. "When we compared the scans side by side, there seemed to be a subtle difference—images from our coil had more noise in them than those from the new coil. Just looking at scans from our coil, we had not noticed any decline in image quality, but obviously there was a difference. We exchanged our old shoulder coil for the new one and went back to work.

"It was very impressive that GE Healthcare was able to detect this issue proactively and bring it to our attention," he adds. "There is clinical value in catching a problem like this at an early stage, before it escalates to something more serious."

For Molnar and Austad, InSite OnWatch proactive technology helped their facilities avoid costly, unplanned downtime by identifying service issues before they occurred. Both sites continued to service patients, preserve imaging revenue and maintain clinical workflow without interruption.

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>
> *Jerry Molnar, Senior Staff MRI Technologist*

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Professor Catherine Oppenheim, MD, PhD,
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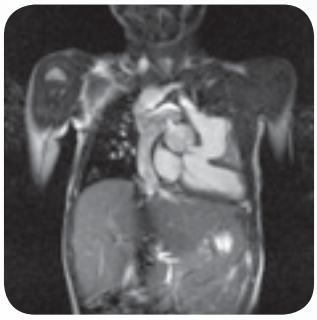
The following live Web seminars feature clinical experts addressing topics important to your practice across a breadth of anatomical areas, including: non-contrast imaging; body imaging; robust imaging under motion or susceptibility; and workflow.

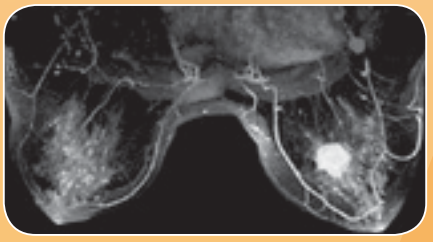


How to Assess the Pediatric and Congenital Heart With Cardiac MR

December 15, 2011–3:00 pm GMT/ 10:00 am ET/9:00 am CT/7:00 am PT
Faculty: Matthew Bramlet, MD, Director of Congenital Cardiac MRI, Children's Hospital of Illinois (Peoria, Ill.) and Kevin Fahey, MD, Director of Cardiothoracic Radiology, OSF Saint Francis Medical Center (Peoria, Ill.).

Learn how to apply CMR in pediatric and congenital heart disease. The speakers will address imaging and post-processing techniques used to evaluate anatomy and physiology in the pediatric and congenital heart. The unique challenges of imaging children will be addressed. Post-processing assessment of the right ventricle will be demonstrated as well as the utility of phase contrast. The presenters will explain how they evaluate the dilated aortic root and aortic arch for objective longitudinal surveillance. The speakers will also provide insights into protocol development for this unique population.

Coming in 2012



Breast MR Imaging: From Basic Principles to Emerging Trends

Breast imaging is one of the fastest growth segments for MR and its role continues to expand as an advanced diagnostic tool. This presentation will cover the principles and emerging trends of breast MR imaging. Common challenges in achieving reliable results will be detailed and protocol suggestions will be provided with representative clinical images. An opportunity for interactive discussion will follow the presentation.

Streamlined MR Workflow for Improved Productivity

Learn about what is new in the Discovery* and Optima* platforms, including a new user interface and applications. The speaker will discuss general workflow using features focused on the patient and technologist, including: iROC (in-room monitor); Express Table; GEM; customizable user interface and protocols; protocol notes with images; Autovoice; linking; in-line-post-processing; and more. The speaker will also highlight new application features that help improve productivity and clinical confidence. S

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