SIEMENS

Vol. 4 No. 3 1996

The MAGNETOM Flash

Newsletter for Siemens MAGNETOM Users • July, 1996 • $3.50

IN THIS ISSUE

FROM THE EDITOR

In this issue of the FLASH we announce upcoming educational seminars and provide a review of two recent Siemens users' meetings. Siemens is pleased to announce some exciting product upgrades now commercially available, including The Turbo Gradients for the MAGNETOM Impact Expert system and the B21B Software Upgrade, the MR-Guided Procedures Package, and the Kinematic Knee Device for the MAGNETOM Open system. Two Siemens users offer their perspectives on a new gadolinium-enhanced technique for MR Angiography of the aorta. A clinical article by a Siemens user discusses his experience with prostate imaging using the CP Body Array Coil rather than an endorectal coil. Technical articles by Siemens applications specialists and a Siemens user offer practical tips on shoulder imaging with the Small CP Flex Coil and the Loop Flex Coil. Finally, the Continuing Saga of Apps Girl unfolds to tickle your lighter side.

All articles represent the techniques and opinions of the authors and may not represent specific recommendations or endorsements from Siemens Medical Systems, Inc. Contact the authors directly for further information about their techniques and opinions.

If you are within the United States, contact Gary McNeal (see below) to submit your contributions, to request previous issues, or to add your name to the mailing list (please, no home addresses). If you are outside the United States, contact Silke Schumann (see below).

Gary R. McNeal, MS

THE MAGNETOM Flash

PUBLISHED BY:
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Siemens Medical Systems, Inc.
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Iselin, NJ, 08830, USA

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CONTINUING EDUCATION: MR TECHNOLOGIST SEMINAR

Michele McDonald, MR Applications Coordinator
Siemens Medical Systems, Iselin, NJ

The Siemens MR Technologist Seminar was held on April 11-13, 1996, at the Omni Inner Harbor Hotel in Baltimore, Maryland. There were presentations given by radiologists, technologists, and Siemens personnel. One hundred technologists from all across the U.S. attended the seminar and there were also a few technologists from Spain and Canada (Figure 1). Technologists were awarded ASRT continuing education credits for their attendance.

The first day focused on MR physic, MR safety, breathhold imaging, and a presentation by the manager of the Siemens MR Applications Group on the education and support programs available to Siemens customers in the U.S. The second day focused on neuro anatomy, MR angiography, cardiac imaging, and orthopedic imaging. In addition, there was a presentation on throughput optimization which provided practical suggestions for making your MR site run more smoothly and efficiently. On the third day, the seminar wrapped up with some very interesting and exciting presentations. The vice-president of the Siemens Imaging Systems Group gave a very insightful presentation on healthcare reform as it is likely to affect MR technologists; in view of today's U.S. healthcare environment, this was a most appropriate and welcomed presentation. Other topics included low-field imaging, clinical use of the endorectal coil for prostate imaging, and echo planar imaging. The final presentation was given by the manager of the Siemens MR Division on the future directions of Siemens MR development efforts.

In addition to lectures, there were also breakout sessions on the afternoons of the first and second days. These breakout sessions provided attending technologists with an interactive and informal setting to discuss specific areas of applications (eg, flex coils, MR angiography, fatsat and shim, cardiac imaging). The highlight of the seminar was the dinner boat cruise on the harbor on Friday evening. Everyone ate, danced, and chatted with new friends during a fun filled evening.

The next Siemens MR Technologist Seminar will be held in the Spring of 1997. Further details will follow in future issues of the FLASH. We always welcome input from you - our users - so if you are interested in speaking at our seminar or have a suggestion for a topic, please contact Michele McDonald, MR Applications Coordinator (phone 908-321-3270, or fax 908-321-3219).

Figure 1: Congratulations for traveling the longest distance to attend the seminar are extended to Yolanda Jauregui and Teresa Almandoz, MR technologists from Osatek Hospital De Galdakao, Bizkaia, North Spain.

CONTINUING EDUCATION: SEMINARS AND MEETINGS

For additional information on any of these meetings, or to include a meeting announcement in our next issue of the FLASH, please contact Michele McDonald, MR Applications Coordinator (phone 908-321-3270, or fax 908-321-3219).

Sep 5-8	8th Annual Meeting, Advances in Mid and Low Field MRI, Buena Vista Palace, Disney World, FL
Sep 12-15	13th International Meeting, European Society of Magnetic Resonance in Medicine and Biology, Prague, Czech Republic
Sep 18-20	8th International Meeting, Society for Minimally Invasive Therapy, Milan, Italy
Oct 20-25	Neuro-Orthopedic Review, MRI Education Foundation, Inc, Cincinnati, OH
Oct 24-27	11th National Symposium, Economics of Diagnostic Imaging, Sheraton Washington Hotel, Washington, DC
Nov 27-29	MRI Orthopedic Workshop, MRI Education Foundation, Inc, Chicago, IL

CONTINUING EDUCATION: MAGNETOM USERS MEETING AT ISMRM

Michele McDonald, MR Applications Coordinator
Siemens Medical Systems, Iselin, NJ

The Siemens MAGNETOM Users Meeting was held on April 27, 1996, at the New York Hilton and Towers in New York City during the International Society of Magnetic Resonance in Medicine meeting. Over 275 radiologists and technologists from around the world attended the meeting. Each presentation lasted about 15 minutes and there was ample time for questions and answers throughout the meeting.

The meeting began with a buffet dinner for all of the attendants and an introduction and welcome by the manager of the Siemens MR Division. The first topic was an update on Spectroscopy by Dr. Michael Weiner of UCSF/VA Medical Center. This was followed by a Diffusion/Perfusion discussion by Dr. Jonathan Wiener of Boca Raton Community Hospital. Dr. Michael Stehling from the Institute für Radiologische Diagnostik, Klinikum Grosshadern d. Universität München spoke on Gd-enhanced Ultrashort TE MRA. These 3 topics were followed by a question and answer period.

Dr. Robert Edelman of Beth Israel Hospital continued with New Frontiers in Fast Imaging: New Turbo Spin Echo Techniques. Dr. David Feinberg of New York University Medical Center followed with a presentation on New Frontiers in Fast Imaging: New Turbo GRASE Techniques. The last two topics of the evening were Cardiac Imaging and an update on Interventional MR. Dr. Kostaki Bis of William Beaumont Hospital gave the cardiac talk and Dr. Jonathan Lewin of Cleveland Clinic wrapped up the meeting with the final topic of Interventional MR.

The topics at this Users' Meeting represented the latest in imaging technology and research in magnetic resonance. In looking at the overall list of topics at this year's ISMRM, Siemens users played a major role leading the world in advanced imaging techniques and hardware/software development.

PRODUCT ANNOUNCEMENT: TURBO GRADIENTS FOR MAGNETOM IMPACT AND IMPACT EXPERT

Siemens is pleased to announce commercial availability of the new Turbo Gradient Upgrade for MAGNETOM Impact and Impact Expert systems. The Turbo Gradients are designed to operate at maximum gradient amplitude of 20 mT/m with minimum rise time of 1.2 ms. Immediate applications for the Turbo Gradients will include smaller FOV (20-30 mm) and 1024 matrix (Figure 1) for improved image resolution, and also TSE sequences with 240 Echo Train Length for strong T2-weighted cholangiography and myelography (Figure 2).

Although the Turbo Gradient Upgrade will increase the peak acoustic noise levels and the time varying magnetic fields (dB/dt), these parameters will remain within FDA specified limits. However, the maximum time averaged acoustic noise level will exceed the 99 dB(A) level specified by the IEC and the 105 dB(A) level specified by OSHA. The noise levels measured are comparable (slightly lower) to those measured for the MAGNETOM Vision system with either its standard gradients or the Gradient Overdrive Booster. As for the Vision, Siemens will include a warning to the user which recommends hearing protection for the patient. But remember, these maximum noise levels are measured under worst case conditions (bipolar gradient pulse, maximum gradient strength, minimum rise time) and these are not typical for most routine clinical exams.

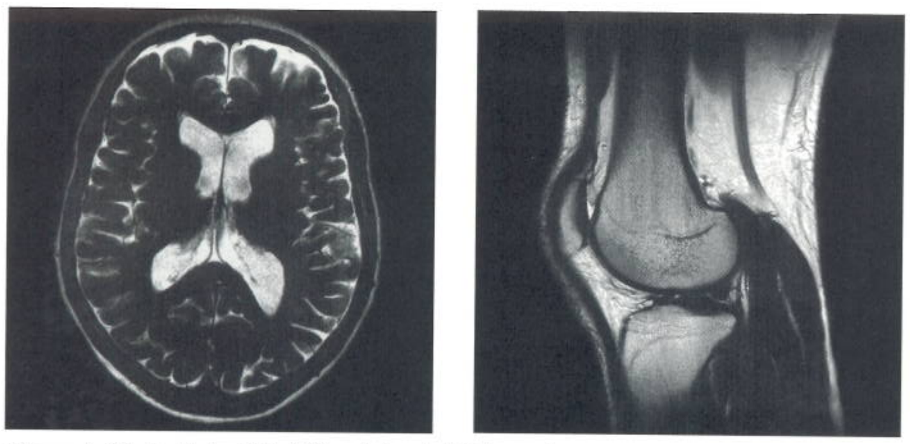

Figure 1: Turbo Spin Echo T2-weighted, 1024 matrix.
(a) transverse brain. *(b) sagittal knee.*

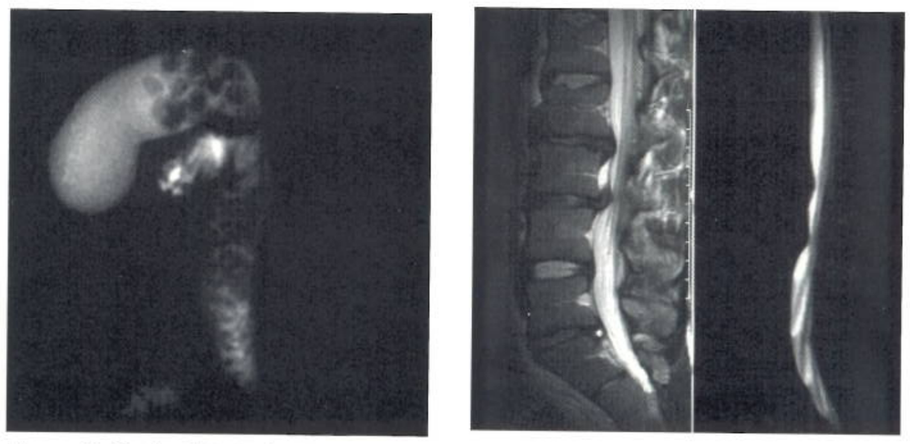

Figure 2: Turbo Spin Echo T2-weighted, 240 Echo Train Length.
(a) 5 sec cholangiogram. *(b) 5 sec myelogram next to 5 min Turbo T2 spine.*

PRODUCT ANNOUNCEMENT: NUMARIS B21B SOFTWARE UPGRADE, MR-GUIDED PROCEDURES PACKAGE, AND KINEMATIC KNEE DEVICE FOR MAGNETOM OPEN

Anne Deery Sheehan, MS, Open Product Manager, Siemens Medical Systems, Iselin, NJ

The year 1993 started a new revolution in open MRI with the introduction of the MAGNETOM Open. Since that time, sales of open equipment have grown to more than 40% of annual MR sales. Today, Siemens announces a "new vision" for open MRI with B21B software.

NEW VISION FOR OPEN MRI

NUMARIS B21B software is the same platform that is used on the MAGNETOM Vision and Impact Expert systems. It includes many "high field" features and imaging techniques which will bring "new vision" to open MRI through expanded image contrast choices, enhanced spatial resolution and improved operator efficiency. Our "seamless" approach to R&D brings high field techniques such as TurboFLAIR, shared echo TSE, and TSE with T1 contrast to the MAGNETOM Open. This software upgrade will be installed free-of-charge for Open systems currently under Siemens service contract or warrantee. For those systems which fit neither category, the software may be purchased for $35,000.

B21B FEATURES

1. Erasable Optical disks - Simply select the optical disk drive under file/delete to erase the active side of the optical archive disk. Your drive will still recognize WORM disks, such as the Pioneer DEC 502, but now you can purchase and use the Read/Write disks, such as the Pioneer DEC 702.

2. Pixel Size Indicator - states the actual pixel size in both phase and frequency encoding directions as you change the matrix, FOV (field-of-view), and RecFOV (rectangular field-of-view).

3. Relative S/N Indicator - states the relative signal-to-noise ratio as you change the slice thickness, number of acquisitions, pixel size, and percentage of phase oversampling. The indicated S/N ratio is relative to that of the saved protocol (100% = 1.00).

4. RecFOV - reduce the FOV in the phase encoding direction to adjust the FOV to the size of the imaged anatomy. This feature automatically decreases the matrix in the phase encoding direction proportional to the selected RecFOV (7/8, 6/8, 5/8, 4/8), thereby reducing the acquisition time without affecting the image resolution.

5. Phase Oversampling - for suppression of aliasing (wrap-around) in the phase encoding direction and in the partition encoding direction (for 3D scans). The amount of oversampling is freely changeable as a percentage of the selected FOV. This feature can be combined with RecFOV where desirable.

6. Measurement / History - throughout the patient exam all the measured protocols are saved in a list so they can be easily recalled, changed, or simply restarted without having to repeat the setup. This saves setup time for repeat scans or for multiple scans at the same slice locations by reusing previous slice and presat positions.

7. Measurement / Queue - setup and queue the next few protocols even during a measurement. After one protocol in the queue is completed and its images are reconstructed, the next protocol is automatically started. At any time the queue can be reviewed, paused, or modified.

8. Measurement / Position - the position platform includes a new "Image Plus" button for paging through the scout study, and also includes a new "Second Localizer" button for positioning slices on two different scout images from two perpendicular planes. This is particularly helpful when using presats and RecFOV.

9. Flexible 3D Partitions - freely selectable number of 3D partitions (in increments of 8) to allow the through-plane resolution to be easily optimized to the size and shape of the imaged anatomy.

10. Evaluate / Filter - a post-processing "adaptive filter" improves the edge enhancement to improve image quality without loss of diagnostic information. Filter parameters are freely selectable, and filtered images are stored as a new study in addition to the unfiltered images (both may be filmed if desired).

11. Integrated MAPShim - a new automated shim algorithm will replace Adjust / Gradient Offset correction to optimize the magnetic field uniformity (the old correction is still possible).

12. Integrated Fat Suppression - applied with a click of a button for some sequences. The fat signal is suppressed by use of an inversion pulse with an appropriate fixed inversion delay time (Inversion Recovery).

13. Integrated MTC - applied with a click of a button for some sequences. The bound water signal is suppressed by use of an off-resonance pulse at an appropriate frequency shift.

14. Study / Display - slices can be displayed on their localizer at the click of a button.

15. Hold / Original - toggle between magnified or scrolled images and their original display at the click of a button.

16. Evaluate / Dynamic Analysis (Optional) - user selectable combination of images with other images or with mathematical functions (add, subtract, divide, T1, T2, Z-score).

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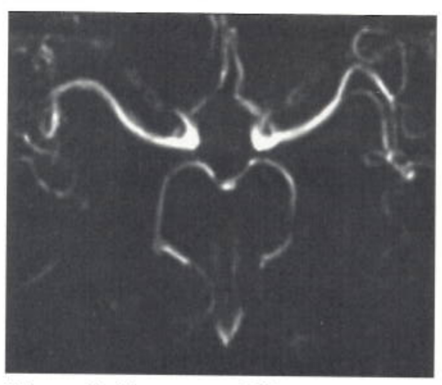

Figure 1: Transverse MIP projection of intracranial MRA acquired transversely with new multislab 3D sequence, MTS applied, 200 mm FOV.

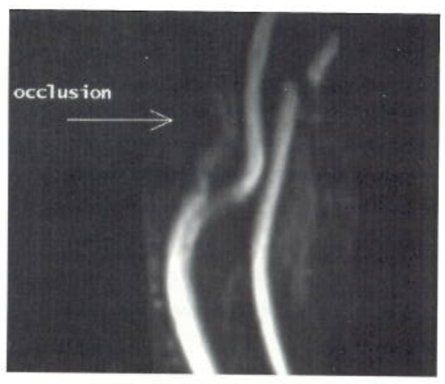

Figure 2: Sagittal MIP projection of carotid occlusion MRA acquired transversely with new sequential 2D traveling presat sequence, 200 mm FOV.

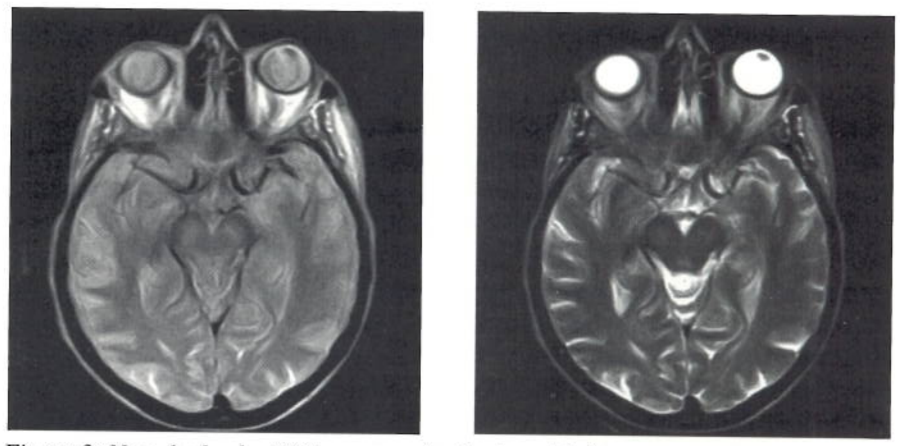

Figure 3: New dual echo TSE sequence for brains with flow compensation in both echoes, twenty 5mm slices in 6:30 min. Siemens exclusive in open MRI !

(continued from previous page)

MR-GUIDED PROCEDURES PACKAGE

The MR-Guided Procedures Package has just received FDA premarket clearance, making the MAGNETOM Open the first commercially available MRI system capable of assisting physicians during interventions. This package consists of hardware, software, and ultrafast breath-hold sequences designed to support diagnostic interventional needle biopsies and drainages. An Autodisplay feature may be used to instantly view the ultrafast breath-hold images as they are acquired on the fly, even while the measurement protocol is still running, thus providing virtually real-time tracking capabilities (fluoro-like MR acquisition).

During an interventional procedure, the interventional radiologist is guided by virtually real-time MR imaging, enabling him/her to avoid critical tissues and structures and to assure that the biopsy needle or catheter is on target when the tissue sample is taken or the drainage is started. Advantages of MR imaging for guided interventional procedures compared to other imaging modalities include radiation free imaging, excellent soft tissue contrast, the capability of arbitrary slice orientation which allows the target lesion and needle entry point to be in the same plane, and 3D volume imaging capabilities. MR-guided diagnostic procedures are well suited for anatomic areas where computed tomography or ultrasound deliver suboptimal imaging results.

The MR-Guided Procedures Package is optional. The In-Room Monitor is a separate option, but must be ordered to support the Autodisplay feature. The MR-Guided Procedures Package contains:

* Fast Imaging Sequences (up to 3 images/second, 2D, 3D, FLASH, TSE5 for T1, TSE15 for T2)
* Autodisplay of images as they are scanned
* Surgical drape for upper magnet pole
* Ergonomic chair
* Foot pedal to initiate scans
* Multipurpose 35cm diameter flexible coil
* Flexible Bore Light

KINEMATIC KNEE DEVICE

Siemens is pleased to announce commercial availability of the Kinematic Knee Device for use with the MAGNETOM Open system. This new device accessory is intended to facilitate kinematic exams through controlled positioning and movement of the knee. It can be used for examination of the left or right knee, and can be adjusted from 0 degrees to 100 degrees, in 5 degree increments. This device is not intended for dynamic examinations since this suggests an examination of the knee while forces are being applied. A new fl2d_23b24 sequence based upon the previous fl2d_25b30 sequence is especially well suited for kinematic exams.

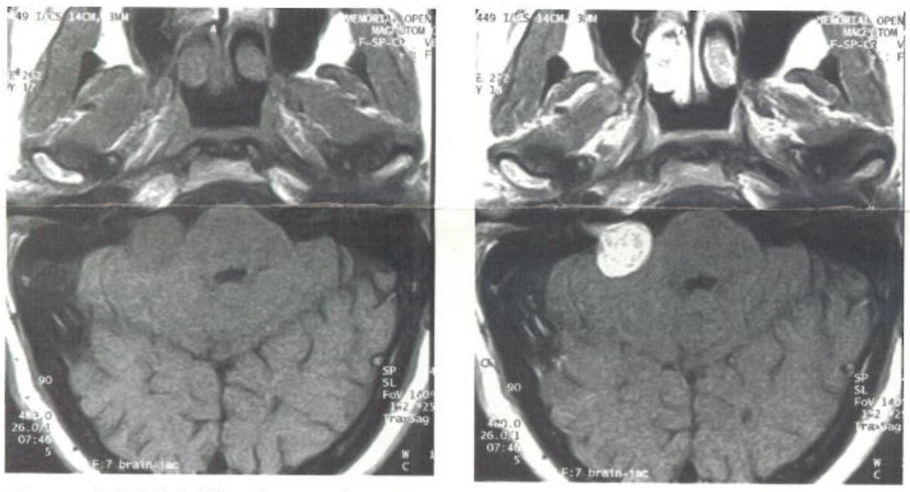

Figure 4: High field techniques benefit open MRI. RecFOV and Phase oversampling were used to obtain this aggressive 160 mm FOV, RecFOV 7/8, Phase Oversampling 25%, 3 mm slice, 7:45 min.

(a) pre-gadolinium. *(b) post-gadolinium.*

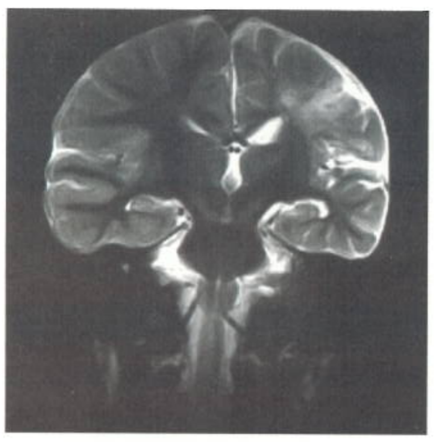

Figure 6: New Turbo IR sequence for pediatric heads with very strong white/grey matter contrast.

Figure 7: Kinematic Knee Device for static positioning of knee during kinematic exams.

Figure 9: MR-Guided Procedures Package being used for interventional needle biopsy or drainage.

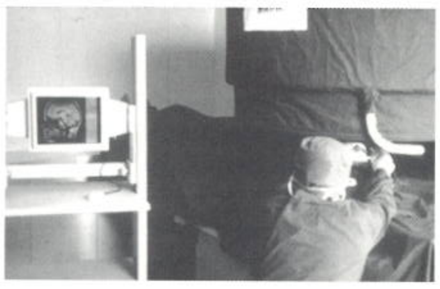

Figure 10: In-Room Monitor being used to operate the MR scanner and review images with Autodisplay.

MR Angiography (traveling presat band is freely selectable for head or feet)

Sequence	Description
fi3d_10rb54	Update of existing sequence, 3D partitions steps of 8
fi3d_s_10rb54	New multislab angio sequence, 3D partitions steps of 8, fixed slab overlap 0.38
fi3d_p2_10rb54	New multislab angio sequence, 3D partitions steps of 2, fixed slab overlap 0.50
fl2d_s_10rb78	Update of existing sequence
fl2d_s_14rb39	Update of existing sequence

Brain and Spine Imaging

Sequence	Description
se_25rb43_112rb17	New sequence for PD/T2 brains, flow comp in both echoes
fl2d_17b39	New sequence for Proton Density brains, faster scan and higher S/N compared to dual spin echo
tse7_117b33	New sequence for T2 brains and L-spines, faster scan and higher S/N compared to dual spin echo
tirm7_ild_93b65	New sequence for TurboFLAIR brains and spines, T2 contrast with dark fluid
tse7_114rrb65	New sequence for T2 C-spines, possible signal void with strong CSF pulsations
fl2d_46rb20	New sequence for brain hemorrhage and T2* C-spines, flow comp and variable TE
fl3d_7b98	New 3D sequence for T1 heads and spines, many slices in short scan time
fl3d_ns_8b56	Same as above, non-selective RF pulse, lower bandwidth
fi3d_7rsb195	New 3D sequence for heads and spines with very strong T2* contrast, flow comp in slice direction
ps3d_13rsb78	New 3D sequence for heads and spines with very strong T2* contrast, flow comp in slice direction
tir7_48b65	New sequence for pediatric heads with very strong white/grey matter contrast
tse240_1100b156	New sequence for myelography and cholangiography with T2 contrast so strong that only fluids are visible

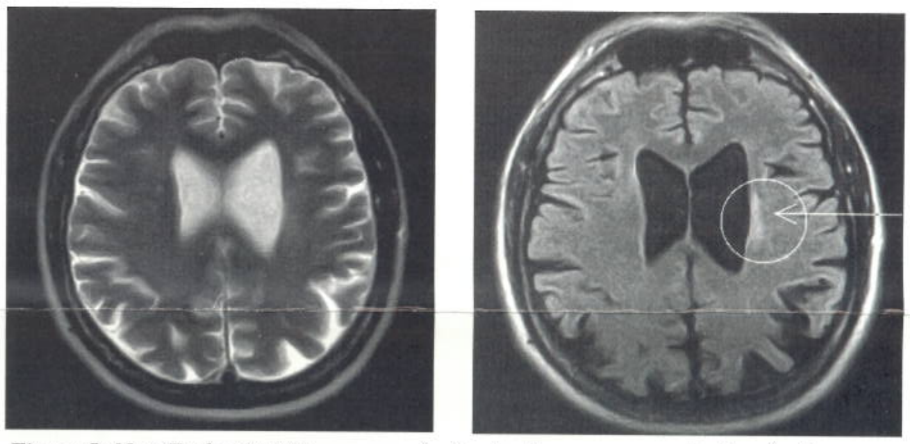

Figure 5: New Turbo FLAIR sequence for brains improves conspicuity of white matter disease. Siemens exclusive in open MRI !
(a) Turbo T2 image barely demonstrates white matter disease next to bright CSF.
(b) Turbo FLAIR image more clearly demonstrates disease next to dark CSF.

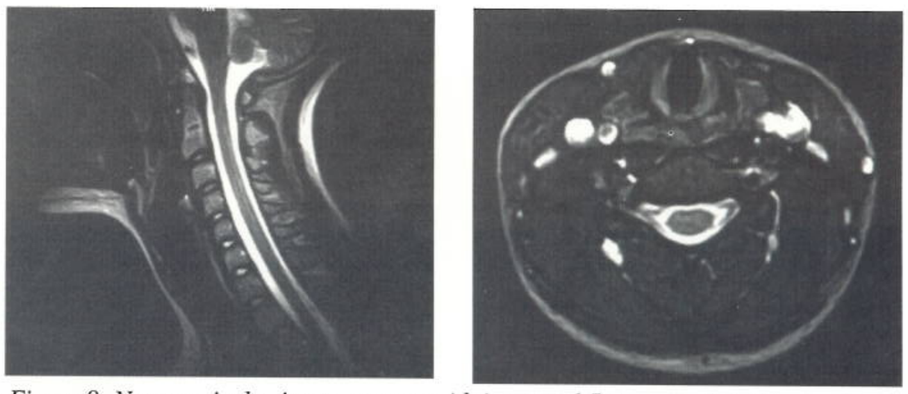

Figure 8: New cervical spine sequences with improved flow compensation.
(a) TSE T2 sagittal, 4 mm slice, 220 mm FOV, RecFOV 7/8, Phase OS 100%.
(b) Flash2D T2 transverse, 3 mm slice, 220 mm FOV.*

THE CONTINUING SAGA: APPS GIRL

Jay Rocker, MS, RT, Applications Specialist
Siemens Medical Systems, Minneapolis, MN

When we last left Apps Girl, her ambition was to become NETWORKED. But, in 1996, getting there was like playing CHESS. You needed FLAIR and DESIRE. She just didn't know all the TRICKS. She tried to HIRE someone, someone to help her be less RINEPT. His name was RUFIS, but he wanted to CARVE his own niche in the RODEO. He wanted to be FAMIS... to be a STAR. You may have heard of him, he is called BATMAN. He rides a horse called PEDRI.

Alone again, she decided it just wasn't FAIR. If she was to CLAW her way up, to make it to the TOMROP, she had to learn GRASE and have FOCI. This wasn't easy. People called her CRAZED. They said when it got CRITICAL, she lost her PIPS and was not OK.

Undaunted, Apps Girl headed for her favorite hangout where she had some PASTA and a DIET PEPSI. Just then, a BRISK wind blew in, followed by a puff of STEAM. That's when she saw him. DANTE. What a guy. BOLD. STIRring. A SPIDER tattoo on his PHAPS and the kind of VERSE she was looking for. He strolled over and said, "Excuse me, do you have any SPARE DIMSUM?" She sighed and began to MORPH right there.

(See page six for glossary of terms used in this story).

ASK THE EXPERTS:

GADOLINIUM-ENHANCED 3D MR ANGIOGRAPHY OF THE AORTA

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{Editor's note: Siemens can promote the use of gadolinium for MR angiography only at an approved dose level and injection rate. Anything more would be considered off-label promotion, i.e.. promotion of an unapproved use. Always consult the product inserts and follow the FDA approved dose levels and injection rates. Unapproved dose or rate should be only used for investigational purposes. Contact the authors by E-mail or Fax for further details regarding dose levels and injection rates.}

We use gadolinium-enhanced 3D MR Angiography (GADO 3D MRA) with increasing frequency in the assessment of a wide range of aortic disorders. In addition to providing a non-invasive and expedient evaluation, it can frequently obviate the need for other imaging procedures. This article discusses a method that can be used for imaging the major thoraco-abdominal vessels with either the standard MAGNETOM gradients or the optional Gradient Overdrive Booster. This method has been used at NYU on the MAGNETOM Vision and Impact Expert systems for assessment of aortic dissection, aortic arch and subclavian artery stenosis and thrombosis, and congenital pediatric anomalies. Additionally, this method has been used at UCSF-VA on the MAGNETOM Vision and 63SP systems for assessment of the major abdominal and pelvic vessels for abdominal aortic aneurysms (AAA). Both institutions, however, continue to begin their patient examinations with traditional MRA acquisitions (i.e., 2D TOF, spin-echo Blackblood, cine, etc.) before attempting a GADO 3D MRA.

The contrast mechanism of GADO 3D MRA is based on the signal difference between bright blood which has been T1-shortened by gadolinium and dark stationary tissue which typically has much longer T1 values. If the maximum allowable dose of gadolinium is injected at the maximum allowable rate, and it is timed to pass through the imaged 3D volume about half-way through the acquisition time (i.e., 1 min. into a 2 min. scan), the brightness of the blood will dominate the image. Thus, the relative timing of the injection and the acquisition is critical for two reasons. First, optimal timing ensures maximum vessel / background contrast. Second, images acquired too long after injection result in a confusing overlap of arteries and veins because gadolinium cycles from arteries into veins within about two minutes. In order for a GADO 3D MRA to be successful, therefore, the scan must be completed during the preferential "arterial-only" phase of contrast enhancement.

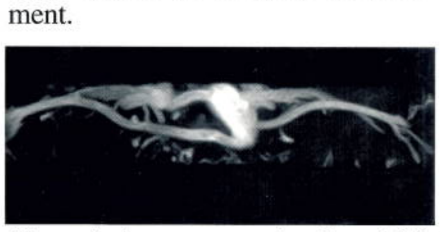

Figure 1: A transverse sub-volume MIP projection from a transversely acquired GADO 3D MRA, 38 partitions of 1 mm each, Fisp3D_6rb195, 1:51 min, reveals an aberrant Rt. subclavian artery (Vision, Body Coil, NYU Med Ctr).

Since the GADO 3D MRA contrast mechanism is completely different from traditional 3D TOF MRA techniques, the following differences exist between the two approaches:

1. Timing the peak contrast enhancement of the aorta during the "arterial-only" phase to occur at the midpoint of raw data acquisition (center of K-space) is critical to the success of GADO 3D MRA.
2. Neither the orientation of the imaged vessel relative to the 3D slab nor the thickness of the slab are considerations in GADO 3D MRA. 3D volumes can be acquired not only transversely, but sagittally or coronally to yield high resolution 3D coverage of a larger region of interest.
3. Use of moderately high flip angles (40-50 deg) in combination with very short TR's (5-25 ms) will not saturate gadolinium-enhanced blood and are, in fact, desirable for optimum background suppression. This is possible because gadolinium-enhanced blood recovers its longitudinal magnetization so quickly that it is almost fully relaxed after only a few milliseconds. Non-enhanced blood takes much longer to recover and, thus, would become saturated under such conditions.

To begin the exam, the patient should be positioned as for any other type of abdominal MRA exam, except that an IV should be started first with a 22 gauge antecubital IV drip of normal saline. First, acquire routine 2D vascular images. Then, prepare for a gadolinium injection using the maximum allowable dose, followed immediately by a saline flush. The scan should be "loaded" and ready to simply hit "start" before any injection is begun. Contrast should be injected at the maximum allowable rate (typically, for a total injection time of 50-60 seconds). NYU has found that a reliable injection scheme for a two minute scan is to start the injection 10 seconds before hitting the "start" button, continue the injection through two-thirds (2/3) of the acquisition, and begin the flush immediately after the injection (flush should start about 40-50 seconds into the scan).

Figure 2(a): A coronal MIP projection from a coronally acquired GADO 3D MRA, 16 partitions of 4 mm each, Fisp3D_16_7rb195, 46 sec, reveals a large AAA. This gross screening technique was selected for rapid imaging of this patient (SP63, Body Coil, UCSF-VA).

Figure 2(b): On the same patient, a transverse MPR reconstruction from the same acquisition reveals the true extent of plaque intrusion into the mid-aorta.

With GADO 3D MRA, imaging of the aorta can be performed in a variety of planes. UCSF-VA has found an orthogonal coronal scan useful for imaging AAAs. NYU uses at least a 400 mm FOV 3D slab covering from the arch vessels to the iliac bifurcation for screening exams of the entire aorta. An oblique para-sagittal projection with an FOV large enough to cover the base of the heart to the distal carotids is used for a dedicated exam of the arch vessels. In the case of the arch exam, the first scan is followed immediately by a second high resolution 512 axial acquisition with a slab thickness sufficient to include the aortic-pulmonary window to the mid- neck (Figure 1).

Given the complexity of the abdominal vasculature, it will be necessary to perform MIP projections utilizing sub-volumes of interest selected to minimize artifacts (i.e., overlapping veins) while maintaining sufficient coverage to orient the viewer to the vessel of interest. It should be noted that these MIP projections are interpretive and act mainly as a "road map" to provide a gross anatomical context for the vasculature involved. Accurate interpretation will depend on a close examination of the individual source partitions. Additionally, MPR reconstructions from the acquired 3D data can show the aorta in alternative anatomical planes and for comparison with 2D studies. This approach can be useful in pinpointing the exact location of lesions such as plaque, thrombus, or stenosis (Figure 2).

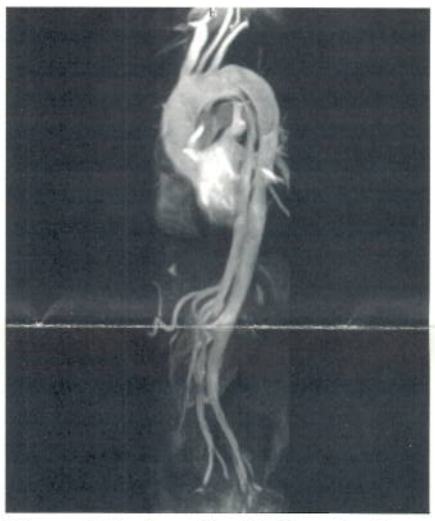

Figure 3(a): A sagittal MIP projection from an oblique sagittally-acquired GADO 3D MRA to rule out aortic dissection, Fisp3D_2b325 (works-in-progress), 30 sec breath-hold, 512 matrix, reveals the great vessels and an intimal flap (type B dissection) posterior to the Lt. subclavian artery (Vision, Body Coil, NYU Med Ctr).

Figure 3(b): On the same patient, a sub-volume oblique sagittal MIP projection from the same acquisition reveals the celiac axis, superior mesenteric artery (SMA), and thrombus in the region of the renal arteries.

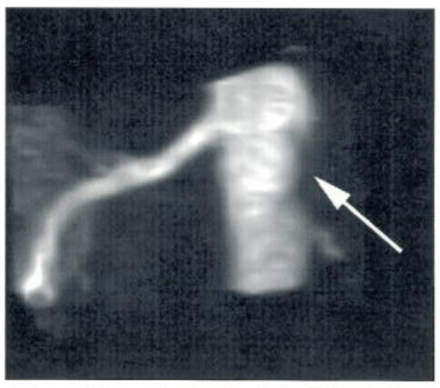

Figure 3(c): On the same patient, sub-volume coronal MIP projection from the same acquisition reveals thrombosis of the Lt. renal artery.

Several research sites are testing 3D MRA sequences that take full advantage of the high performance gradients now available on the MAGNETOM Vision system (Gradient Overdrive Booster) and the MAGNETOM Impact Expert system (Turbo Gradients). These powerful gradients allow for a substantial reduction in the minimum TE's available for MR angiographic use. Shorter TE's (2-3 ms) allow the use of shorter TR's (5-6 ms) which allow, for the first time, the acquisition of a high resolution (512) GADO 3D MRA scan within a 30 second breath-hold. This technique holds the greatest promise for successful, robust MR angiography of the aorta (Figures 3,4). These short TR/TE sequences are currently works-in-progress, but will be available with software version B31A for the MAGNETOM Vision and Impact Expert systems in the late Fall of 1996. As these sequences come into more widespread use, look for additional articles covering state-of-the-art investigational methods for GADO 3D MRA of the renal, visceral, and peripheral arteries.

Figure 4(a): A coronal MIP projection from a coronally acquired GADO 3D MRA, Fisp3D_2b325 (works-in-progress), 27 sec breath-hold, 40 partitions of 2 mm each, on a healthy volunteer (Vision, Body Coil, HealthSouth Doctors Hospital, Coral Gables, FL).

Figure 4(b): On a different subject, coronal MIP projection from a GADO 3D MRA acquired with the center of K-space occurring at about 100 seconds post injection of maximum allowable dose of gadolinium contrast. Note the poor contrast between the aorta and background at this delayed time due to missing the peak "arterial phase" of contrast in the aorta.

CLINICAL ARTICLE: MR IMAGING OF THE PROSTATE WITH THE CP BODY ARRAY COIL

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Although most MR users believe that the endorectal coil provides a substantial improvement over the body coil for imaging the prostate, there are some practical problems with the endorectal coil that are often ignored or glossed over in the published literature. For instance, each endorectal coil costs about $100.00, and you will not get reimbursed for it. The effective depth of signal penetration is only about 4 cm. This can be a problem since the anterior aspect of the gland and bladder neck may not be well visualized with the endorectal coil alone. The images generated by an endorectal coil may also be compromised by near field high signal intensity which may obscure the posterior prostate capsule, and by ghosting artifacts from motion of the coil within the rectum during acquisition which can interfere with evaluation of the posterior prostate and the neurovascular bundles (Figure 1). Signal normalization techniques can mitigate the near field burn out but result in loss of signal in the near field, including the posterior prostate capsule. We have also found that filming the endorectal coil images can be very challenging, and to optimally evaluate the anterior and posterior fields, images may have to be viewed with two different window settings. Most users of endorectal coils will tell you that there is a pretty steep learning curve for image interpretation. If you don't do a lot of them, you may never achieve very good results.

But perhaps the biggest problem with the endorectal coil is that it is an endorectal coil. Unless you want to deal with a potential mess, the patient should have their bowel prepped prior to the exam. Furthermore, despite arguments to the contrary, placement of the endorectal coil is painful for some patients, and occasionally a patient will complain of severe pain or just not tolerate the procedure. I don't believe that glucagon really makes a substantial difference in this regard. On more than one occasion, at the completion of the exam with the endorectal coil, a patient has commented that they never want to go through that exam again. That is not terrific public relations for MRI. And don't forget the set-up time which requires that the coil be tested and tuned. We have had several occasions where the endorectal coil did not tune outside the patient, and others where it tuned outside the patient but not after it was inserted. This is reality. Sometimes the coil has to be repositioned after a scout shows that it is either too high or too low. The question we asked ourselves was "Is the endorectal coil really necessary". Can we get the same diagnostic outcome with the CP Body Array Coil?

Our experience with the CP Body Array Coil, used in conjunction with high-performance gradients and Turbo Spin Echo sequences, suggests that high quality images of the prostate may be obtained without the use of an endorectal coil. By allowing high resolution imaging of the prostate without the invasiveness and inconvenience of the endorectal coil, the CP Body Array Coil simplifies and shortens the MRI examination of the prostate, greatly increasing its acceptability to both patients and medical personnel. Some of the problems associated with endorectal coils, such as ghosting and near field high signal, are avoided (Figure 2).

Is the diagnostic accuracy with the CP Body Array Coil equivalent to that achievable with the endorectal coil? I don't know. I have not done a scientific study on the subject, and I probably never will. We did perform endorectal coil prostate MR imaging for several years before Siemens made the CP Body Array Coil available, and we subsequently performed both endorectal coil and array coil studies on a few patients. We concluded that the high resolution images we achieved using the Siemens Turbo Spin Echo sequences and CP Body Array Coil were at least as good as the endorectal coil images obtained with another manufacturer's equipment that was used in studies that reported very high quality prostate imaging. So, assuming our diagnostic skills are equal to those at other places, we should do as well. The exam is acceptable to every non-claustrophobic patient. They don't have to be prepped, there is no pain, and it goes faster. Furthermore, since there are no artifacts to contend with we no longer have to occasionally include statements in our reports like "evaluation of the neurovascular bundles and prostate capsule was limited due to ghosting artifacts". No urologist wants to receive a report like that.

Interpretation of prostate MRI is difficult under any circumstances. Gross extracapsular extension will be evaluated well with either an endorectal coil or the CP Body Array Coil. While there is no doubt that the signal-to-noise ratio at the posterior aspect of the prostate is better with the endorectal coil, there are also more artifacts. So, sometimes you will see subtle changes in the prostate contour or capsule with the endorectal coil that are not appreciated with just the CP Body Array Coil, and sometimes it is the other way around. What is the significance of these subtle changes? This is an area of controversy. Some people think that they can reliably tell which ones represent extracapsular extension and which ones represent post-biopsy or reactive changes. Personally, I think it is often a roll of the dice, and I am not certain that it matters since evidence of minimal or equivocal extracapsular extension may not preclude surgical intervention.

We use the CP Body Array Coil rather than an endorectal coil for prostate imaging, but I don't think one can be dogmatic about this subject. There are pluses and minuses of both. If you like endorectal coils, use them. If you don't, the CP Body Array Coil is a viable alternative. This approach has not won me any popularity contests with the manufacturers of endorectal coils, but you have to find these things out for yourself. Do not assume that the published results using equipment from another manufacturer necessarily apply to your equipment.

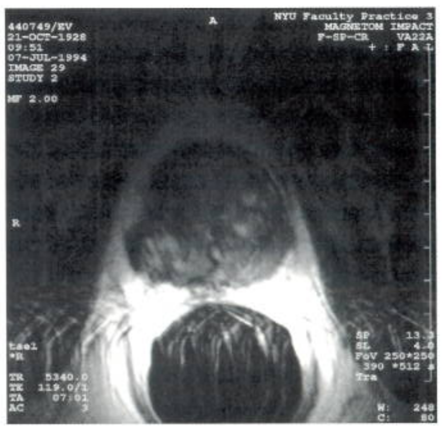

Figure 1: Endorectal coil. T2-weighted Turbo Spin Echo endorectal coil image is of no diagnostic value due to near field burn out and ghost artifacts. Most endorectal coil studies are substantially better than this, but even an occasional study like this is unacceptable.

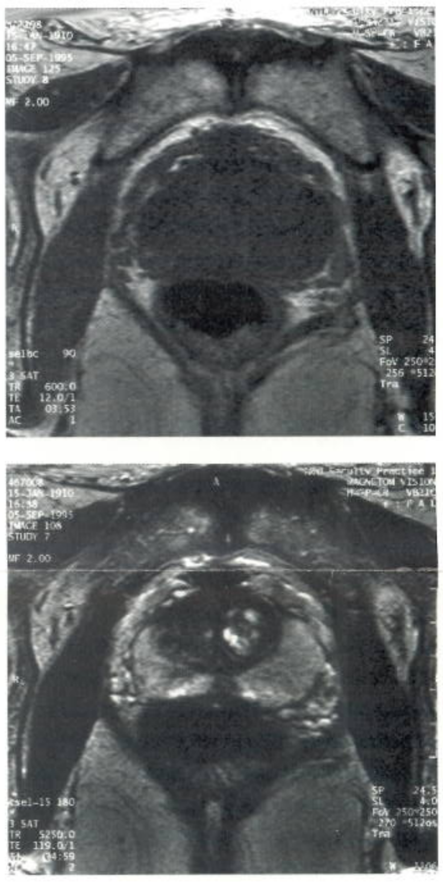

Figure 2: On a different patient, CP Body Array Coil images demonstrate no ghosting or near field high signal artifacts.
(a) T1-weighted Spin Echo.
(b) T2-weighted Turbo Spin Echo.

TECHNICAL ARTICLE: MR IMAGING OF THE SHOULDER WITH THE FLEX LOOP COIL

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Proper positioning of both the patient and the surface coil are of utmost importance for successful MR imaging of the shoulder. The patient's shoulder should be as close as possible to the isocenter of the magnet to assure optimal image quality, and yet the patient must be as comfortable as possible to assure a motion-free examination. After trying a variety of sequences, coils, and positioning techniques on our MAGNETOM Impact Expert, we have concluded that the surface coil of choice for shoulder imaging is the Flex Loop Coil. The techniques we describe in this article are applicable for the MAGNETOM Vision and Impact, as well.

Although the shoulder should ideally be placed at isocenter for optimal image quality, this is not practical. Siemens offers a Flex Coil Package for off-center FOV imaging which consists of a Large CP Flex Coil, a Small CP Flex Coil, a Flex Loop Coil, and an Interface Cable which is compatible with each. In general, for a variety of examinations, all three coils combine high signal-to-noise ratio and high resolution with ease of positioning and patient comfort. But, we find that the Flex Loop Coil is best for shoulder imaging because it is the easiest to position, the most comfortable for the patient, and the least sensitive to respiratory motion artifacts (particularly with larger patients).

With the patient either sitting on the edge of the table or lying supine, place the patient's hand and arm through the loop, slide the loop up the arm, and position the loop over the shoulder and under the armpit, with the cable lying between the arm and the body (Figure 4). Line the

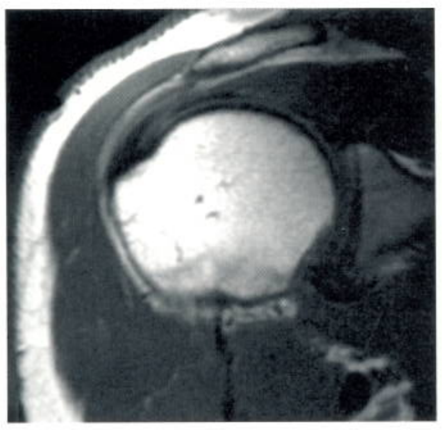

Figure 1: Standard SE T1 coronal shoulder image.

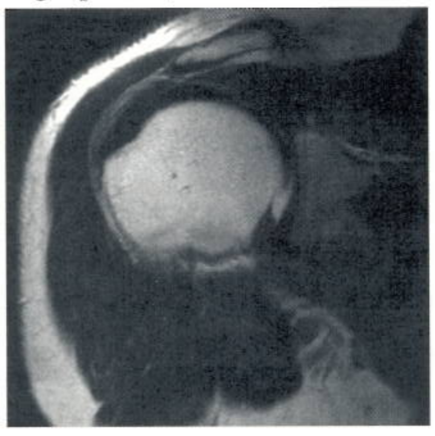

Figure 2: Standard Turbo T2 coronal shoulder image.

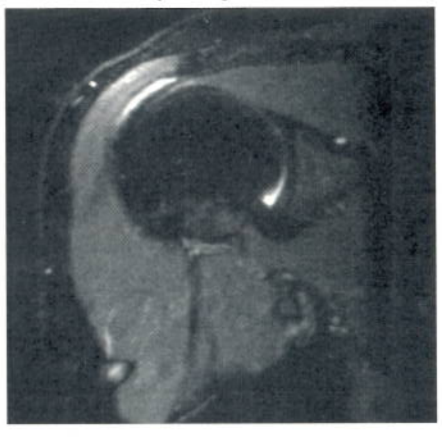

Figure 3: Optional Turbo IR coronal shoulder image.

(continued from previous page)

inside of the loop with towels or foam rubber pads to keep the coil from touching the shoulder, to provide stability for the coil, and to eliminate "hot-spots" in the images where the coil is too close to the skin. After the patient is lying down, plug the coil into its interface cable and route the cable out between the patient's arm and body. If necessary, when imaging the right shoulder, you should route the interface cable under the supplied cut-out pad so that it can pass under the patient to the opposite side of the table. After re-checking to ensure that the coil is still correctly positioned over the medial aspect of the humeral head, connect the interface cable to the magnet or table. For added patient comfort and safety, wrap the interface cable in towels or foam rubber pads to isolate it from the patient and secure the arm with Velcro straps stretched across the chest (Figure 5). Align the localizer light to the center of the patient's humeral head and move the patient into the magnet. Instruct the patient to slide over as far as possible to the opposite side of the bore so that the imaged shoulder is as close as possible to the isocenter. Tune the coil and begin the examination.

We have found it helpful to have several different sets of protocols available from which to choose. Although 5 to 7 minute protocols are tolerated by most patients, some much faster protocols may be required for patients with claustrophobia or severe pain. Even these faster protocols are quite acceptable to our radiologists.

Figure 4: Positioning the Flex Loop Coil on the patient's shoulder.

Figure 5: Securing the patient's arm and shoulder with Velcro straps.

PROTOCOL	SEQUENCE	TR/TE/TI/FLIP	SLI/SAT	THICK	GAP	MATRIX	ACQ	FOV	TIME
STANDARD									
T1 CORONAL	SE_14B89	TR=530 TE=14 Flip=90°	SLI=15 SAT=1	4	.10	172X256,o PhOS 70%	2	160 REC7	5:13
Turbo PD/T2 CORONAL	TSE5_45B130 _90B130	TR=3000 TE=45/90 Flip=180°	SLI=14 SAT=1	4	.20	250x512,o PhOS 36%	2	190 REC7	6:55
FLASH TRANSVERSE	FL2D _18RB78	TR=570 TE=18 Flip=20°	SLI=17	4	.20	193x256,o PhOS 35%	2	160 REC7	5:00
OPTIONAL									
Turbo PD/T2 CORONAL	TSE5_45B130 _90B130	TR=3000 TE=45/90 Flip=180°	SLI=14 SAT=1	4	.20	180x256,o PhOS 36%	1	160 REC7	2:28
PD/T2 CORONAL	SE_20B78 _55B78	TR=2100 TE=20/80 Flip=90°	SLI=13 SAT=1	4	.20	168x256,o PhOS 30%	1	160 REC7	7:41
Turbo IR CORONAL	TIRM7 _30B130	TR=4000 TE=30 TI=150 Flip=180°	SLI=15 SAT=1	4	.20	168x256,o PhOs 50%	2	160 REC7	4:53

TECHNICAL ARTICLE:

MR IMAGING OF THE SHOULDER WITH THE SMALL CP FLEX COIL

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In the late Spring of 1996, an applications support video entitled CP COILS was released by Siemens to recommend optimal positioning techniques for the CP Flex Coils, the CP Spine Array Coil, and the CP Body Array Coil. In the US, two copies were mailed to the Chief Technologist at each MAGNETOM Vision, Impact, and Expert site having any of these new flex or array coils. For additional copies of this video while supplies last, contact your local Siemens MR Sales / Applications Specialist or the Siemens MR Applications Hotline (800-333-3137).

The CP COILS video recommends using the CP Flex Coils wrapped around the lateral aspect of the shoulder with the accessory arm to stabilize the coil on the shoulder (Figure 1). The video also recommends using the Large CP Flex Coil for medium to large sized patients, or the Small CP Flex Coil for small to medium sized patients. At the time the video was produced in the late Fall of 1995, these were thought to be the optimal positioning techniques for these two flexible coils. However, more recent experiences among advanced users of these coils suggests a slight modification to the original Siemens recommendations. To best avoid respiratory motion artifacts when using the CP Flex Coils, I recommend using the Small CP Flex Coil on all but the largest patients with a moderate angulation (40-45 deg) from the lateral aspect toward the superior aspect of the shoulder. This technique consistently provides superior image quality for shoulder exams, even with large patients who are scanned with a small FOV (160 mm). Although a very slight loss in SNR (15%) may occur due to the moderate angulation, this loss is relatively insignificant compared to the great advantage of reduced respiratory motion artifacts due to less sampling of the lung field. Coil drop-off takes place at the lung rather than at the supraspinatus muscle. Another great advantage is the uniformity of signal throughout the shoulder girdle instead of the usual signal drop-off seen medially to the glenoid.

Proper positioning of the small CP Flex Coil is essential for superior image quality. First, wrap the coil around the lateral aspect of the shoulder, with the center line of the coil positioned at the level of the humeral head (Figure 1). However, before securing the coil with the accessory arm or Velcro straps, angulate the coil up by about 40-45 degrees toward the superior aspect of the shoulder, while still maintaining the center line of the coil over the humeral head. Use the humeral head as your fulcrum point during the angulation. Finally, to hold the coil in place, wrap Velcro straps from behind the patient's shoulder, across the top of the shoulder, across the medial edge of the coil, and back under the armpit, then attach the accessory arm to the anterior surface of the coil (Figure 2). Remember, the coil cable should be routed out underneath the patient's arm, never on top, to avoid movement of the coil caused by patient breathing or body movements. After the shoulder has been centered under the localizer light, drive the table into the bore and have the patient slide as far as possible toward the opposite side to get the shoulder of interest as close as possible to the isocenter. Having the patient slightly rolled up on his side with a cushion supporting his back will allow him to slide further over toward the opposite side. The imaged shoulder should be at least within the edge of the patient table, not all the way over touching the inside of the bore.

Figure 1: Good - CP Flex Coil wrapped around lateral aspect of shoulder, using accessory arm.

Figure 2: Better - CP Flex Coil is angulated 40-45 deg, cupped over lateral-superior aspect of shoulder, Velcro straps wrapped from behind shoulder, across top of shoulder, across medial edge of coil, and back under armpit, then accessory arm attached to anterior surface of coil, with cables routed out underneath patient's arm.

APPS GIRL: GLOSSARY OF TERMS (continued from page 3)

CHESS - chemical shift selective
FLAIR - fluid attenuated inversion recovery
DESIRE - diffusional enhancement of signal intensity and resolution
TRICKS - time resolved imaging of contrast kinetics
HIRE - high intensity reduction
RINEPT - refocused insensitive nucleus enhancement by polarization transfer
RUFIS - rotating ultrafast imaging sequence
CARVE - completely arbitrary regional volume excitation
RODEO - rotating delivery of excitation off resonance
FAMIS - factor analysis of medical image sequences
STAR - signal targeting with alternating radio frequency
BATMAN - batch multislab angiography
PEDRI - proton-electron double resonance imaging
FAIR - flow sensitivity inversion recovery
CLAW - continuous labeling of arterial water
TOMROP - T one by multiple readout pulse
GRASE - gradient and spin echo
CRAZED - COSY revamped with asymmetric Z gradient echo detection
CRITICAL - contrast reduced imaging of tissue concentration & arterial level
PIPS - phase incremented progressive saturation
OK - outer k-space
PASTA - polarity-altered spectral and spatial selective acquisition
DIET - dual interleaved echo train
PEPSI - proton echo-planar spectroscopic imaging
BRISK - block regional interpolation scheme for k-space
STEAM - stimulated echo acquisition mode
DANTE - delays alternating with nutation for tailored excitation
BOLD - blood oxygen level dependent
STIR - short tau inversion recovery
SPIDER - spiral imaging with delayed echo refocussing
PHAPS - phase alternating phase shift
VERSE - variable rate selective excitation
SPARE - single point acquisition with relaxation enhancement
DIMSUM - dynamic imaging via square-hole minimization