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MAGNETOM FLASH

An Applications Reference for Siemens Magnetom Users

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FROM THE EDITOR:

This issue highlights the new Siemens MR products presented at RSNA 1996 and reveals our goals for future product developments.

One of the primary goals of this publication is to share clinical and technical ideas among our MR users. This issue features clinical articles that demonstrate optimized shoulder imaging and TMJ imaging with our CP Flex Coils, as well as a case history that demonstrates the efficacy of using all the MRA tools available in the Siemens arsenal for detecting renal and iliac artery disease. Also from our users, one applications tip accomplishes a carotid MRA exam on a patient whose neck is too large to comfortably fit into the neck coil on the MAGNETOM Open system, while another applications tip indicates how to conveniently match up the slice positions of two smaller sets of T1 images (short TR) to a larger set of T2 images (long TR).

Our MR Applications Hotline helps us keep a finger on the pulse of our MR users — in this issue, the Hotline helps you understand how to avoid a Multi Slice Multi Angle error due to slice positioning, and how to avoid common flow void and false line artifacts.

And finally, to help you optimize the new contrast-enhanced MRA techniques which are becoming more commonly used, we announce the Medrad Spectris™ MR Injection System which has been approved by Siemens for use with our MAGNETOM products.

If you are within the United States, contact me 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 Dagmar Thomsik-Schröpfer.

Gary McNeal, Editor

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APPLICATIONS BULLETIN
For Siemens MAGNETOM Users
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TECHNICAL EDITOR

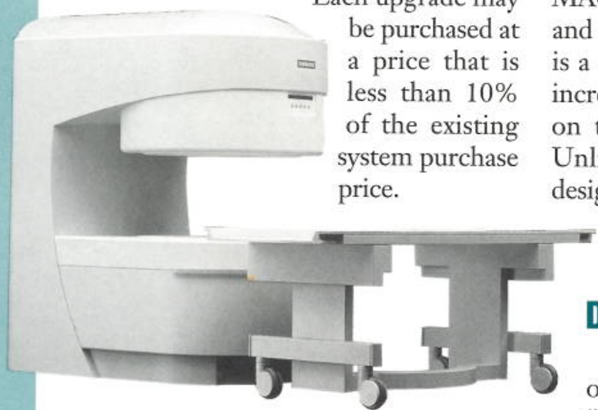
RSNA '96 Update

JOE CAMARATTA, MR DIVISION MANAGER
SIEMENS MEDICAL SYSTEMS, ISELIN, NJ

RSNA 1996 was an exciting time for Siemens customers. The Siemens theme was "Improving Your Outcomes", and the MR Division chose the message "Innovative Solutions to Keep You Ahead" to demonstrate how our products help customers address today's healthcare challenges. There are two key points to our message: innovation and customer solutions.

MAGNETOM Open *viva*

The MAGNETOM Open *viva* is the industry's first truly upgradeable open MR that combines the ultimate in patient comfort with high-field capabilities. While other open MRI manufacturers force their customers to replace the entire system in order to remain competitive, Siemens supports its installed base through a series of upgrades to the Open *viva* platform. Each upgrade may be purchased at a price that is less than 10% of the existing system purchase price.



Comprehensive Cardiac Exam

Siemens extended its leadership in cardiovascular MR with the industry's first comprehensive cardiac exam on the MAGNETOM Vision and Impact Expert platforms. This enhanced cardiac package includes capabilities for obtaining morphological, functional, and angiographic information about the heart. In addition to the non-invasive benefits of MR, the comprehensive cardiac exam collects information that is only obtainable today by using several different, more costly modalities. The package also contains our unique Argus post-processing software that reduces the time needed to analyze the data from over 2 hours to under 20 minutes.

TurboSPARC Processor Plus Upgrade

Our continuing goal is to introduce new clinical applications with exam times of 30 minutes or less. Many of today's new non-anatomical applications require advanced postprocessing capabilities to quantify and graph data for diagnosis. For customers who wish to use these applications without lengthening scheduled exam times, we introduce the Plus upgrade for the MAGNETOM Vision, Impact Expert, and Open platforms. The Plus upgrade is a new turboSPARC processor that increases the speed of post-processing on the main and satellite consoles. Unlike our competition, the modular design of our systems allows us to offer this upgrade without a costly computer replacement.

Dedicated Head Scanner

The MR "innovation corner" offered customers the opportunity to "Touch the Future of MR." We previewed a dedicated head scanner that simultaneously reduces costs, expands applications, and improves patient acceptance of MR exams without compromising quality. We solicited feedback from our customers on the design of the system, its performance specifications, and the possible uses of such a scanner. Our starting point for such a scanner is MAGNETOM Vision performance — a 1.5T scanner with 25mT/m gradients and 300 usec rise times. We are interested in exploring uses of the scanner for neuroscience research, trauma applications, and a cost-effective 2nd or 3rd scanner in a busy practice.

Information about this product is preliminary. The product is under development and not commercially available in the U.S., and its future availability cannot be ensured.

Customer Success Stories

Our second major message was "customer solutions". The exhibit panels labeled "Improving Your Outcomes" displayed powerful testimonials from existing Vision, Impact Expert, and Open customers on the clinical and economical benefits they have experienced from the MAGNETOM product line. These panels showed the value of working with the innovation leader — Siemens. Noteworthy was the fact that the images on the cardiovascular panels were not from the laboratory or only one or two clinical sites, but from a number of clinical sites around the world. While the product is new, the techniques have already been clinically validated, and are ready to make an immediate positive impact on our customers' referrals. Finally, we presented another industry first: an MR-Guided Procedures package that represents the experience of 500 clinical procedures performed at 10 sites.

The message to our customers is clear: "Innovative Solutions To Keep You Ahead" — ahead of increasing demands by referring physicians and administrators, ahead of the challenges of today's managed care environment, and ahead of your competitors.

Meetings And Seminars 1997

For additional information or to include a meeting announcement in a future issue of the FLASH, contact Michele McDonald, MR Applications Coordinator (phone 908-321-3270, fax 908-321-3219).

Mar 3-7, Apr 7-11, Jun 2-6, Jul 14-18, Aug 25-29, Oct 6-10, Nov 17-21: MR Imaging Concepts and Applications Course, Siemens Training Center, Cary, NC

Feb 1: N.W. Regional SMRT Seminar, Evergreen Hospital Medical Center, Kirkland, WA

Feb 13-17: Annual Meeting of American Assoc. of Orthopedic Surgeons, San Francisco, CA

Feb 17-21: PARGEN Sequence Programming Course, Siemens Training Center, Cary, NC

Feb 19-21: Fourth Annual MRI Conference for Technologists, Northwest Imaging Forums, Luxor Hotel and Casino, Las Vegas, NV

Mar 2-7: Snowmass 1997 MRI in Clinical Practice, Educational Symposia, Snowmass, CO

Mar 3-7: European Congress of Radiology, Vienna, Austria

Apr 12-18: Fifth Scientific Meeting and Exhibition of the International Society for Magnetic Resonance In Medicine, Vancouver, BC, Canada

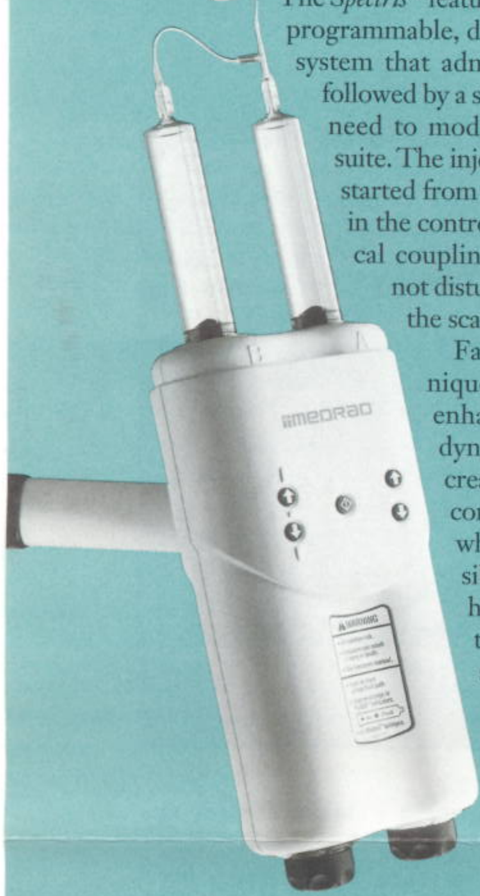
May 8-10: Annual MR Technologist Seminar, Siemens Medical Systems, San Diego, CA

PRODUCT ANNOUNCEMENT:

SPECTRIS™ MR Injection System

The *Spectris*™ MR Injection System (Medrad, Inc., Indianola, PA, phone 412-767-2400) is an MR-compatible contrast injection system which has been approved for use with Siemens MAGNETOM Vision, Impact Basic, and Impact Expert systems (not yet for the MAGNETOM Open). The *Spectris*™ has already demonstrated its efficacy at a number of MR sites by delivering precise, consistent, and cost-effective doses of contrast media. The *Spectris*™ features a battery-powered, programmable, dual front-load syringe system that administers the contrast followed by a saline flush without the need to modify the MR scanning suite. The injection can be remotely started from the operator's console in the control room using an optical coupling system which does not disturb the RF shielding of the scan room.

Faster scanning techniques such as contrast-enhanced body MRA and dynamic scanning have created a need for precise contrast injection timing which is virtually impossible with conventional hand delivered injections. The Spectris system helps deliver a tight, precisely timed bolus which achieves consistently excellent results.

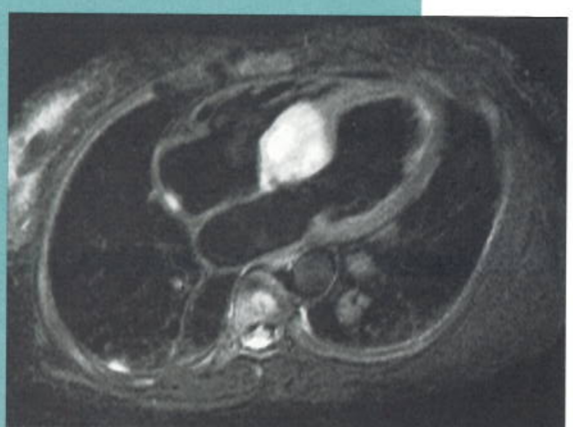


Dual 65 ml front-load disposable *Quik-Fit Syringes*™ and injector head.

PRODUCT ANNOUNCMENT:

Comprehensive Cardiac Exam

Siemens is proud to announce commercial availability of the Comprehensive Cardiac Exam available for the MAGNETOM Vision and Impact Expert systems (B3.1A software, to be released early in 1997). This package allows evaluation of morphology, function, flow, coronary angiography, and automated contouring for quantitative analysis with the new ARGUS program. New advanced techniques include breath-hold spin echo imaging (T1, T2, STIR, HASTE), dark-blood preparatory pulses, retrospective cardiac gating, respiratory navigator pulses, phase contrast quantitative flow, ultrashort TE gradient echo (2D & 3D), and breath-hold segmented cine.



Metastatic tumor in ventricular septum. Turbo spin echo STIR image acquired with cardiac gating over 1 1/2 minutes for motion free and pathology sensitive cardiac imaging.

Photo courtesy of Dr. Rick White, Cleveland Clinic

CASE HISTORY:

Renal And Iliac MR Angio With The Body Coil On The MAGNETOM Impact Expert

ROBERT MARZINSKY, R.T. (R)(MR), CHIEF MRI TECHNOLOGIST
MICHAEL MASONE, R.T. (R)(MR), OPERATIONS MANAGER
CAPITAL IMAGING ASSOCIATES, LATHAM, NY

This case is a great example of what was discussed at the Siemens MR Users Meeting in Baltimore this past spring. Everything in the Siemens MR Angiography (MRA) arsenal was used, including 2D and 3D Time-of-Flight (TOF) as well as 2D and 3D Phase Contrast (PC). As discussed at the meeting, TOF and PC should be used together to compliment each other, as was so well demonstrated in this case. The 2D PC showed the inferior mesenteric artery (IMA) with blood flow in the opposite direction to the aorta; this would not have been demonstrated with just TOF sequences.

History

A 35 year old male presented in 1995 with leg weakness, gait disturbance, hypertension, abdominal pain and cramping, peripheral vascular disease, decreased renal function, hypercoagulable state, and absent left pedal pulse. Due to the hypercoagulability of this patient, it was felt that he was at risk for a catheter angiogram. MRA of the distal aorta and iliac arteries was ordered.

1995 MR Angio Findings

The right iliac artery was stenotic and the left iliac artery was occluded with distal filling via collaterals. The patient was sent for angioplasty to a tertiary care center.

1995 Conventional Angio Findings

The right iliac artery was stenotic and the left iliac artery was occluded with distal filling via collaterals. Also, the left renal artery was stenotic, the superior mesenteric artery (SMA) was occluded, and the IMA supplying the bowel was markedly enlarged. The patient underwent angioplasty of the left renal artery and both iliac arteries. The symptoms subsided and the left pedal pulse returned.

1996 MR Angio Findings

In 1996 a follow-up MRA of the aorta, renal arteries, and iliac arteries was ordered. The left renal artery was again stenotic, the SMA was again occluded, the IMA was again markedly enlarged, both iliac arteries were again stenotic, and the left femoral artery was stenotic. The 2D PC sequence showed the IMA with retrograde flow.

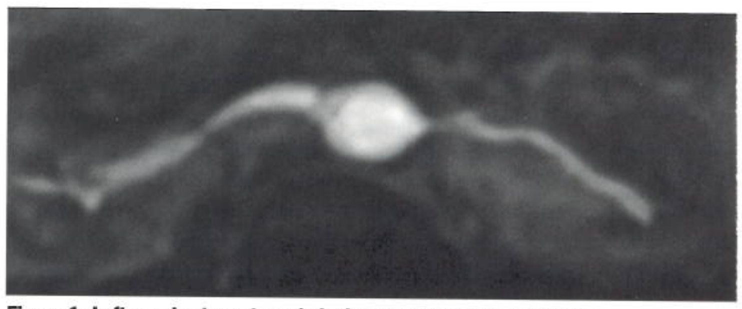


**Figure 1- Left renal artery stenosis is demonstrated by a transverse MIP of a transverse 3D TOF acquisition:
Seq= fi3d_tdn_10rb108.wfc with Tone Down, TR= 30 ms, TE= 10 ms, Flip= 20, FOV= 350 mm, RecFOV= 6, Slab= 52 mm, Partitions= 52, Matrix= 192 x 256,o, Acq= 1, Filter= no, Presat= 1 inferior, Swap= no, Time= 5:02 min.**

**Figure 2 - Left renal artery stenosis is demonstrated by a coronal MIP of a transverse 3D PC acquisition:
Seq= fl3d_pc_30_30_30_9fb108.wfc with Vopt 30 cm/sec, TR= 117 ms, TE= 9 ms, Flip= 12, FOV= 300 mm, RecFOV= 7, Slab= 54 mm, Partitions= 38, Matrix= 168 x 256,o, Acq= 1, Filter= no, Presat= 1 inferior, Swap= no, Time= 12:29 min.**

**Figure 3 - SMA is not visualized and IMA is markedly enlarged to supply collateral flow, as demonstrated by the addition of two coronal 2D PC acquisitions at different Vopt values:
Seq= fl2d_pc_30_30_30_9fb108.wfc with Vopt 30 cm/sec, and Seq= fl2d_pc_45_45_45_9fb108.wfc with Vopt 45 cm/sec, TR= 86 ms, TE= 9 ms, Flip= 10, FOV= 400 mm, RecFOV= 6, Slab= 100 mm, Matrix= 160 x 256,o, Acq= 5, Filter= no, Presat= no, Swap= no, Time= 1:11 min (x2), two images combined using eval/manipulate/add, then combined image filtered with GOP F:7.**

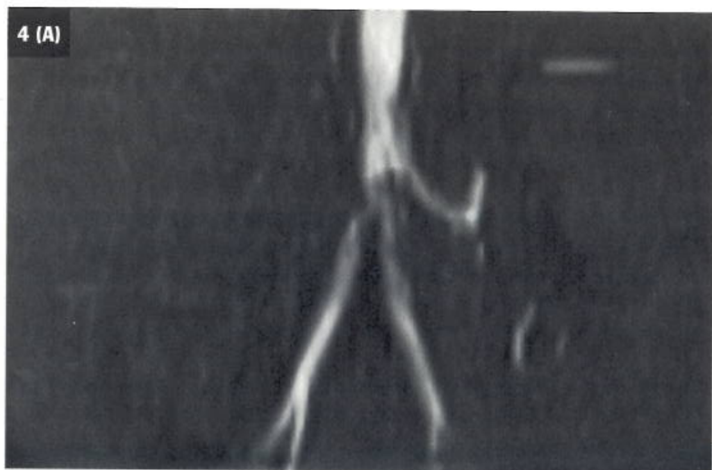
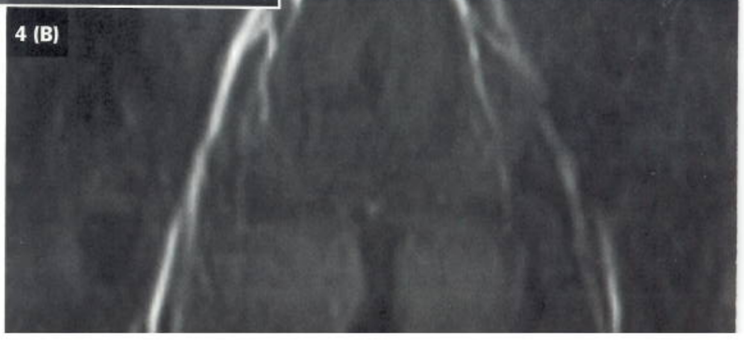


**Figure 4 - (A) Bilateral stenosis of the iliac arteries and (B) stenosis of the left femoral artery are demonstrated by coronal MIP's of transverse 2D TOF acquisitions:
Seq= fl2d_s_9rb195.wfc with TravSat, TR= 25 ms, TE= 9 ms, Flip= 40, FOV= 400 mm, RecFOV= 6, Thickness= 5 mm, DI= -0.3, Slices= 64, Series= ascending, Matrix= 160 x 256,o, Acq= 1, Filter= no, Presat= tracking toward feet, Swap= no, Time= 5:21 min.**



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page 2

CLINICAL ARTICLE:

Shoulder Imaging With The Small CP Flex Coil On The MAGNETOM 63SP

SCOTT BURTON, R.T. (R)(MR)(ARRT), SENIOR MRI TECHNOLOGIST
UNIVERSITY MEDICAL CENTER, LUBBOCK, TX

One of the most difficult orthopedic exams to perform consistently is the shoulder exam. The complex geometry and anatomy of the shoulder joint require extraordinary technical demands such as off-center FOV and very specific coil configurations. Uncomfortable or uncooperative patients typically contribute to poor image quality. Furthermore, the close proximity of the shoulder joint to the thorax can create artifacts produced by the patient's respirations.

The shoulder is considered a loose joint. It actually consists of three joints: the glenohumeral, the acromioclavicular, and the scapulothoracic. The stability of the joint is dependent upon the soft-tissue anatomy surrounding it. The rotator cuff is a thick, tenacious, tendonous sheet that provides stability for normal function. The muscles that comprise it are the suprascapularis, supraspinatus, teras-minor, and the infraspinatus. The areas of interest when doing a shoulder exam are the rotator cuff, glenohumeral ligament, and the labrum. Shoulder exams are performed to evaluate neoplasia, instability, acute trauma, osteonecrosis, suprascapular rotator syndrome, and inflammatory disease (Reference 1).

Intra-Articular Injection

Intra-articular injections of saline diluted Gadopentetate Dimeglumine (gadolinium) are sometimes used to evaluate rotator cuff tears with great success. Fluoroscopy is typically used by the radiologist to guide these injections. Various gadolinium/saline ratios may be used for this procedure. We have found that 0.15 cc of gadolinium mixed with 30.0 cc of saline is the optimum ratio. Iodinated contrast is first injected to evaluate correct needle placement under fluoroscopy, followed by the gadolinium/saline mixture. No more than a total of 8.0 cc is injected.

At present, flow compensation (GMR) and fast scan times are used to help eliminate motion artifacts. A new positioning technique has also been developed that consistently reduces image artifacts to provide high quality images.

Patient And Coil Positioning

This positioning technique evolved gradually over the course of several shoulder exams. On a somewhat petite patient, our routine protocols and positioning technique produced "less than optimal" images. We then placed the patient's shoulder onto the Small FOV Loop Coil while she lay in a prone position. Although the signal-to-noise ratio (SNR) was inadequate, there was a marked decrease in respiratory motion artifacts. For the next patient, we changed to the Small CP Flex Coil and obliqued her slightly to accommodate her larger size in the bore. This positioning technique has consistently provided a high degree of image quality and patient comfort during shoulder exams. When placed in this position, the patient's weight "locks" the affected arm into place. The immobilization actually comforts the patient's shoulder during the scan. The advantage of this positioning technique is that it is neither system nor software dependent.

The patient is placed on the table in the prone position. The Small CP Flex Coil is wrapped over the top of the shoulder joint, with the cable running down the outside of the patient's arm. A velcro strap is used to secure the coil by running it through the axilla. The patient is then rotated onto the affected side (Figure 1). The opposite arm and leg are flexed to support the patient onto the shoulder of interest. This position is similar to a RAO as used in an Upper GI procedure. The patient has to be rotated so that the anterior thorax touches the table as little as possible. The arm of the shoulder of interest is placed straight down the side of the body. The hand is placed with the palm against the patient's lower buttocks. In order to maintain external rotation, a towel is wrapped around the wrist and secured with velcro straps. It is important to instruct patients not to relax and roll down out of this position. Additional pillows or cushions may help maintain this position. The patient is registered "Head-first, Prone".

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Seq:	se_18b78	ma_se_20b78_55b78	ma_flash2d_18rb78
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TR:	680 ms	2000 ms	600 ms
TE:	18 ms	20 / 70 ms	18 ms
Flip:	90 deg	90 deg	70 deg
Thick:	3 mm	3 mm	4 mm
Slices:	15	15	12
DI:	0.2	0.2	0.1
Matrix:	384 x 512,o	256,h x 512,o	160 x 256,o
FOV:	160 mm	160 mm	160 mm
RecFOV:	no	no	no
Acq:	2	2	3
Filter:	fermi (w)	no	fermi (w)
Series:	interleaved	interleaved	interleaved
Swap:	no	no	yes
Presat:	1	2	1

Protocols

The paracoronal images are prescribed parallel to the supraspinatus tendon and muscle (Figure 2). The parasagittal images are prescribed perpendicular to the supraspinatus tendon and muscle. Paracoronal T2-weighted images are invaluable for evaluating micro-tears in the rotator cuff. A transverse FLASH2D sequence is used to rule out labral tears (Figure 3). T1-weighted images are acquired post-contrast in both paracoronal and parasagittal planes (Figure 4).

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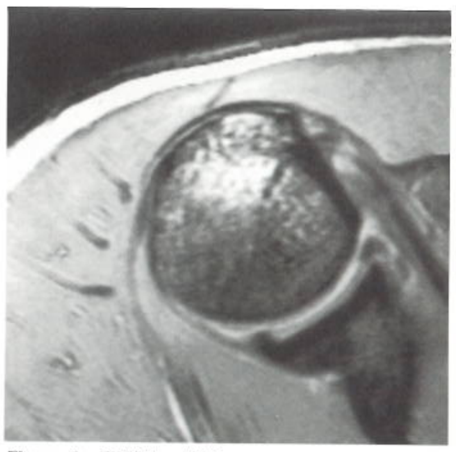
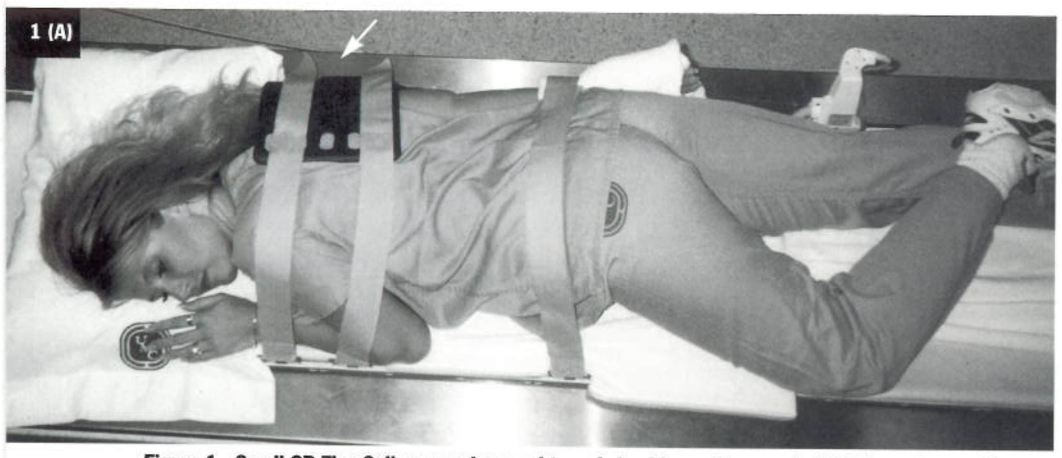


Figure 3 - FLASH axial images.



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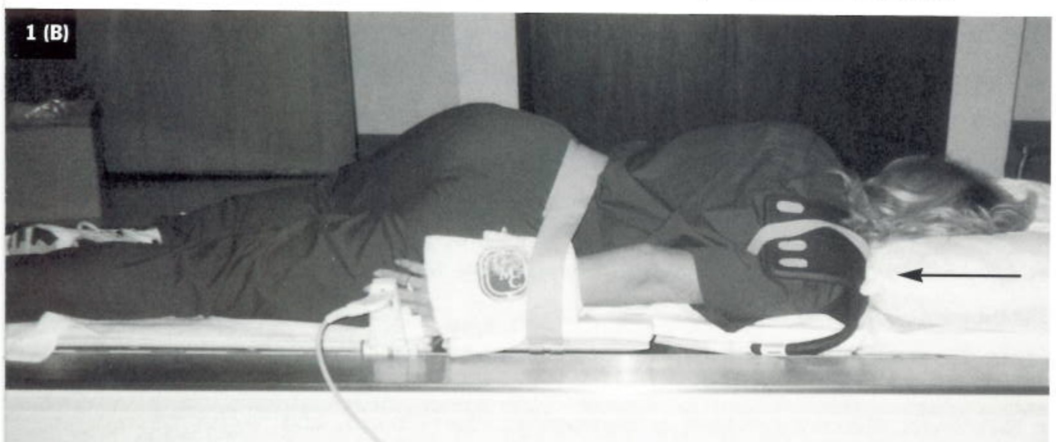


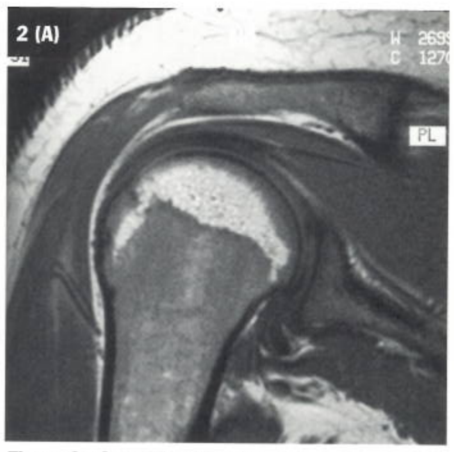
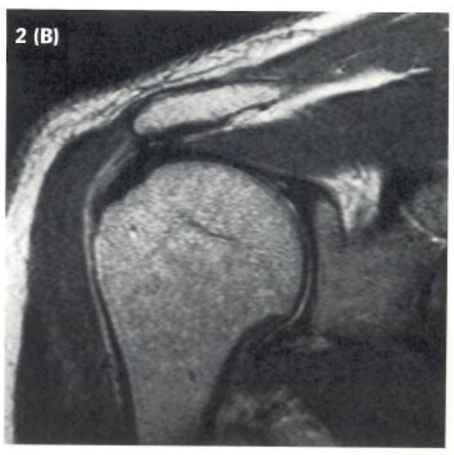


Figure 2 - Coronal oblique images. (A) T1-weighted. (B) T2-weighted.



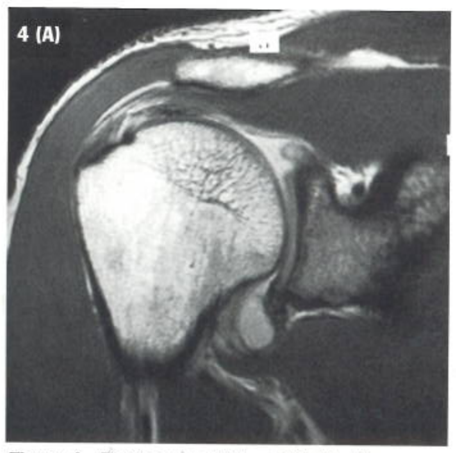
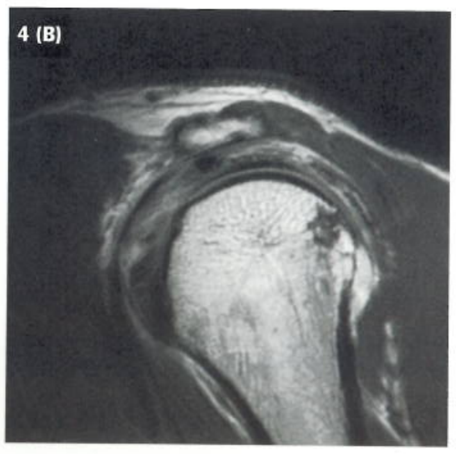


Figure 4 - Post-contrast T1-weighted arthrogram images. (A) Coronal oblique. (B) Sagittal oblique.



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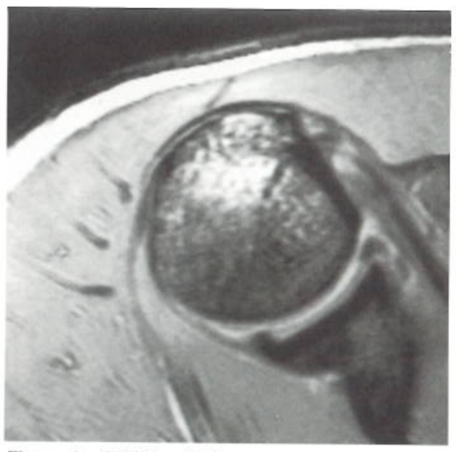

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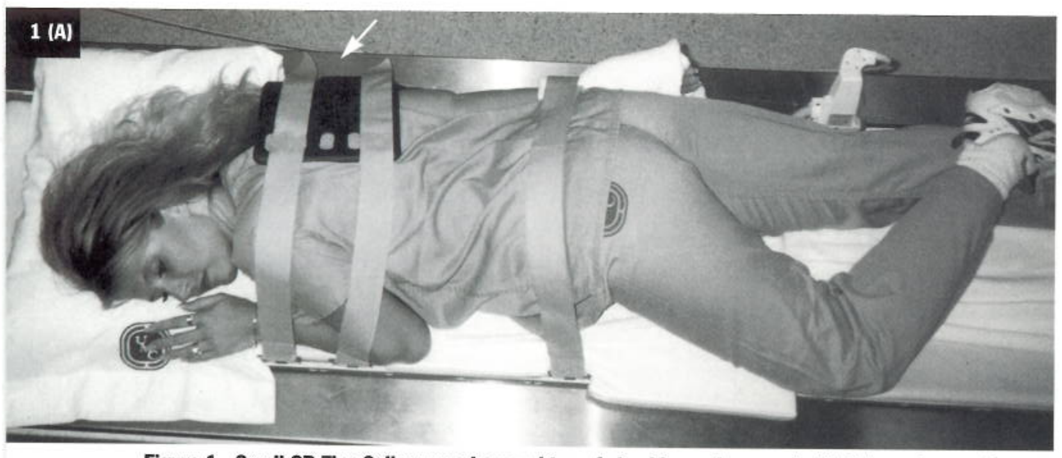


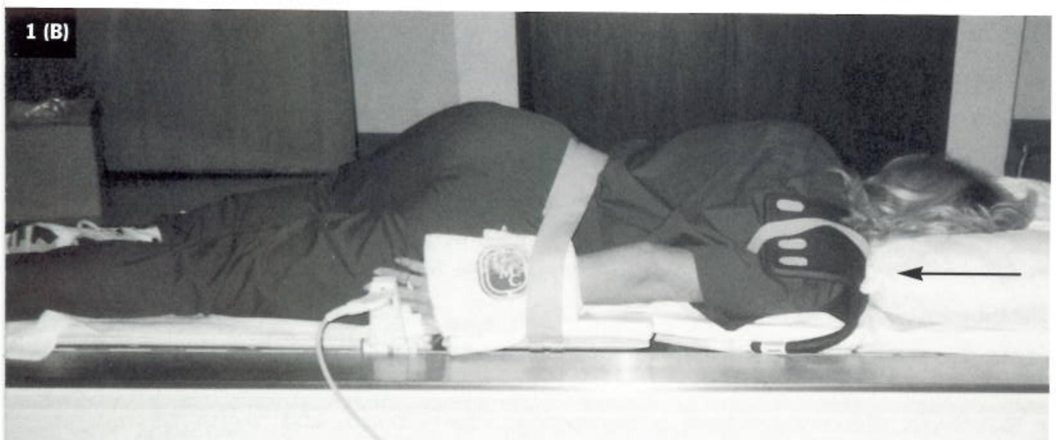
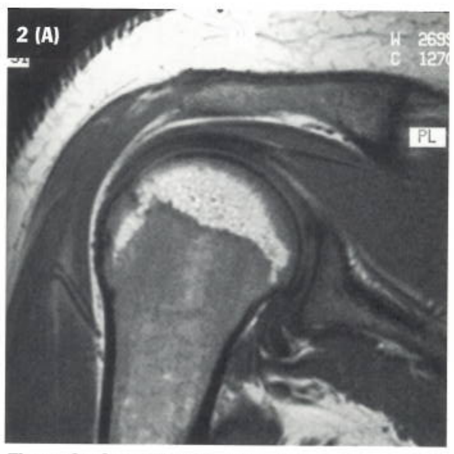


Figure 1 - Small CP Flex Coil wrapped around top of shoulder and secured with Velcro strap under axilla. (A) Top view, noting earlier coil placement. (B) Side view, noting final coil placement.



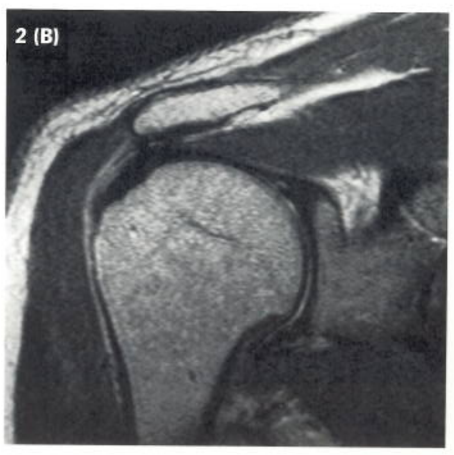
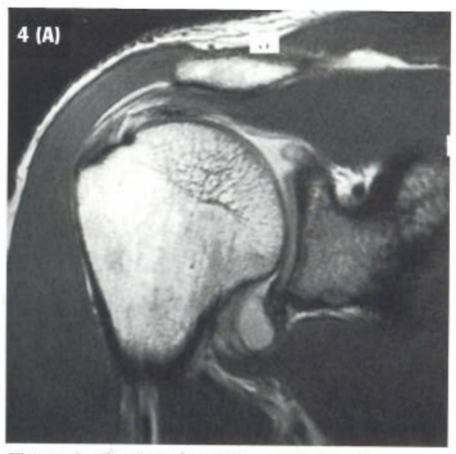


Figure 2 - Coronal oblique images. (A) T1-weighted. (B) T2-weighted.



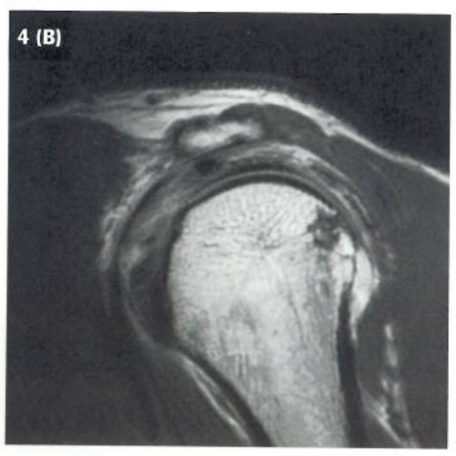


Figure 4 - Post-contrast T1-weighted arthrogram images. (A) Coronal oblique. (B) Sagittal oblique.

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CLINICAL ARTICLE:

TMJ Imaging With The Large CP Flex Coil On The MAGNETOM Vision

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The principle objective of any MR department is to routinely provide diagnostic image quality, regardless of the anatomy being imaged. With this as our primary concern, we evaluated the effectiveness of using the Large CP Flex Coil in imaging temporomandibular joints (TMJ's). Although it may seem challenging to image bilateral TMJ's without a dedicated TMJ coil, we found that the Large CP Flex Coil easily provided more than acceptable image quality.

Patient And Coil Positioning

First, position the flex coil on the table with its "pigtail" entering the cutout at the superior end of the "flex pad" and route the interface cable under the "flex pad" to exit the side cutout (Figure 1). Center the coil from side to side within the bore of the magnet and lay a thin foam pad on top of the coil and another thicker foam pad beneath the coil. These foam pads will serve to cushion the back of the patient's head from the small, hard, thickened central portion of the flex coil. Next, position the patient supine with his head lying on the center of the coil and pad, allowing the technologist to fold up each side of the coil to symmetrically cover both TMJ's (Figure 2). To reduce the high signal intensity at the surface of the skin and to maximize patient comfort and cooperation, place thin foam pads between the TMJ areas and the coil. To secure the flex coil into position, wrap thin Velcro straps completely around the coil in the forehead region as well as under the chin (Figure 2). After placing the Velcro straps under the chin, verify that the patient still has adequate flexibility to position the jaw for the "open" mouth views. Use the wide gray Velcro straps that attach to the table to immobilize the patient's head. Finally, place in the patient's hand the device that he will bite to create the "open" mouth views and fully explain how and when to use the device.

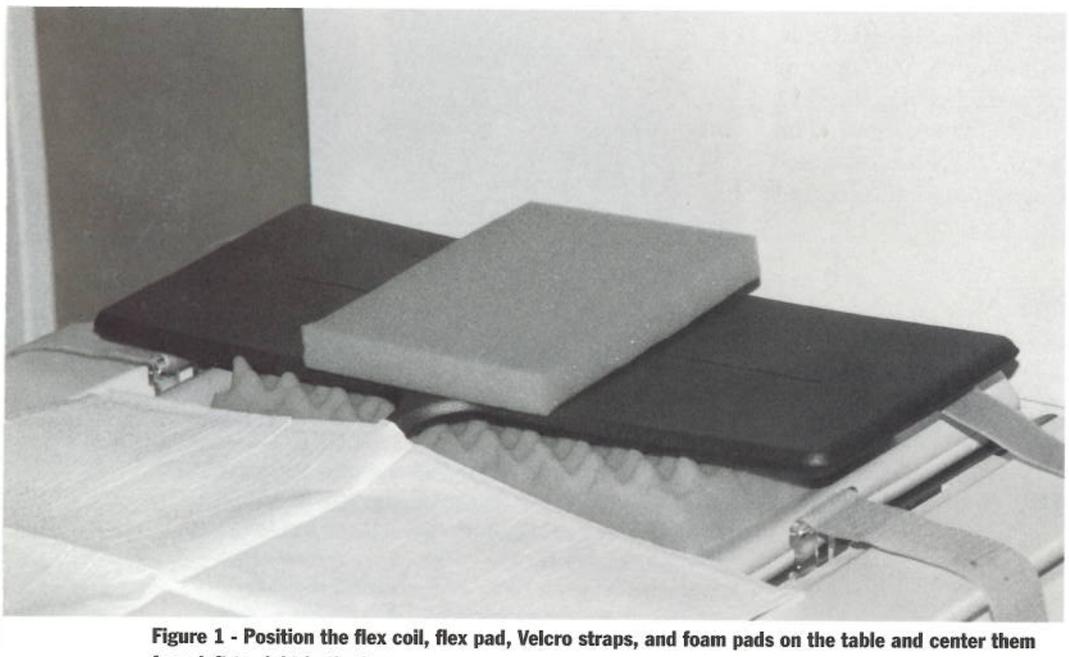


Figure 1 - Position the flex coil, flex pad, Velcro straps, and foam pads on the table and center them from left to right in the bore.

Figure 2 - Center the patient's head on the coil, fold up each side to symmetrically cover both TMJ's, use thin foam pads as spacers between the TMJ's and the coil, secure the coil and the head with Velcro straps.

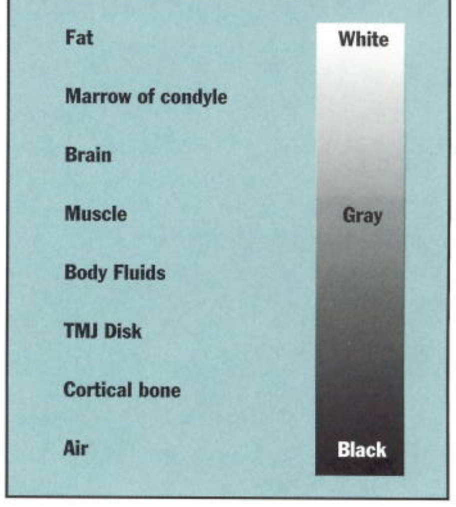
Technical Parameters

Imaging techniques will vary depending on the clinician's preference for routine TMJ sequences. However, due to the high incidence of bilateral TMJ disease, it is necessary to simultaneously image both joints for a thorough examination. To obtain high resolution, small FOV images, always use both readout and phase oversampling to substantially reduce or eliminate aliasing (wrap) and to slightly increase the Signal-to-Noise Ratio (SNR).

In general, TMJ imaging includes axial localizers ("closed" and "open" mouth), sagittal oblique planes, and coronal oblique planes. Localizers are acquired in both the "closed" and "open" mouth views to ensure the accuracy of positioning for the oblique planes. Additionally, the use of oblique scan planes rather than traditional orthogonal sagittal and coronal planes improves the visualization of the TMJ anatomy.

Numerous MRI pulse sequences and imaging parameters exist which can adequately demonstrate the TMJ's; typically the technologist will acquire T1-, PD-, and T2-weighted images. T1-weighted images maximize inherent tissue contrast by enhancing the relative signal of fat and bone marrow in comparison to muscle and the fibrocartilage disk of the TMJ (Figure 3, Reference 1). Images with echo times of 20 ms or shorter provide no significant difference between a T1-weighted image versus a PD-weighted image. T2-weighted images provide more information when the clinician suspects joint infection, inflammation, or neoplasm (Figure 4, Reference 1).

Figure 3 - Relative brightness of body tissues on T1- or PD-weighted spin echo sequence (Reference 1).



Using the axial localizers, position the sagittal oblique slices perpendicular to the horizontal axis of the mandibular condyle (Figure 5) to obtain T1-weighted "closed" and "open" mouth views (Figure 6) as well as T2-weighted "closed" mouth views (Figure 7). Then, position the coronal oblique slices parallel to the horizontal axis of the mandibular condyle (Figure 8) to obtain T1-weighted "closed" mouth views (Figure 9). The sagittal obliques will demonstrate any anterior or posterior disk displacement, while the coronal obliques will demonstrate any medial or lateral disk displacement.

Many factors affect the Signal-to-Noise Ratio of an MRI scan. Of particular interest in this case is slice thickness and matrix versus acquisition

Figure 4 - Temporomandibular joint anatomy and MRI parameters (Reference 1).

TR	TE	EFFECT	TERMINOLOGY	RESULTS
Short	Short	Highlights fat	T1 weighting	Lateral pterygoid fat accentuated
				Posterior disk ligament accentuated
				Disk signal intensity low
				Condylar marrow signal accentuated
				Excellent anatomic detail
Long	Short	Highlights fat	Proton density	Similar effects as T1 weighting
Long	Long	Highlights water	T2 weighting	Joint effusion accentuated
				Bone marrow edema accentuated
				Poor anatomic detail

time. Thinner slices improve visualization of detail, but with a proportional reduction in SNR. In order to maintain SNR with a thinner slice, the number of acquisitions must be increased, resulting in a longer scan time. However, after acute trauma or if the patient has intra-articular injuries, "open" mouth imaging can potentially be painful and difficult for the patient to perform. Although reducing the number of acquisitions will decrease the SNR, an uncomfortable patient will spend less time in the "open" mouth position and, thus, lower SNR may be acceptable if the TMJ disk is clearly depicted in the "closed" mouth views (Reference 1). Furthermore, the use Turbo Spin Echo or Gradient Echo rather than conventional Spin Echo sequences can significantly reduce scan times; these time-savings can be reinvested into additional acquisitions to produce a good compromise between acceptable scan times and acceptable SNR.

Conclusion

If clear instructions are given to the patient concerning the importance of remaining still and if care is taken to position the patient in a comfortable manner, the Large CP Flex Coil provides the clinician with an alternative tool to obtain diagnostic images of the TMJ's.

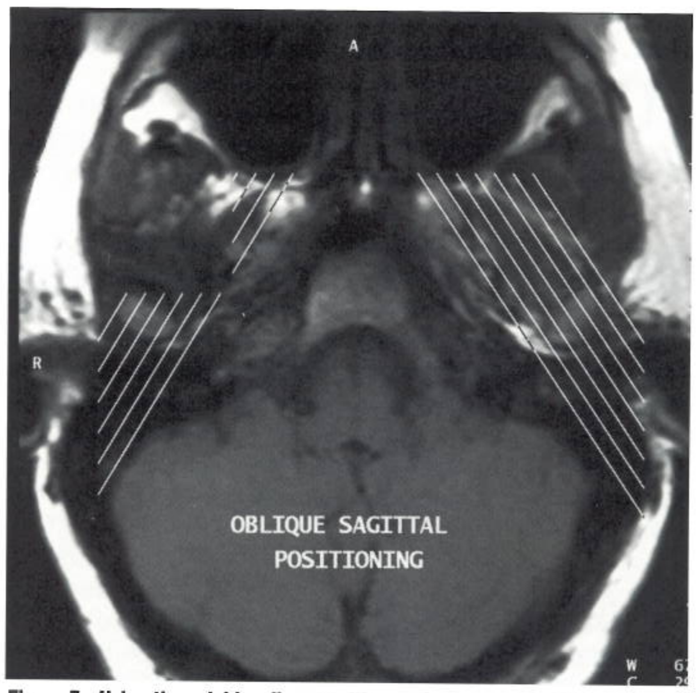


Figure 5 - Using the axial localizer, position sagittal oblique slices perpendicular to horizontal axis of mandibular condyle.

Reference 1 - R. Edelman, J. Hesselink, M. Zlatkin, Clinical Magnetic Resonance Imaging, Vol. 2, W.B. Saunders, Philadelphia, PA pp. 2024-2031.

Reference 2 - I. Bassett, R. Gold, L. Seeger, MRI Atlas of the Musculoskeletal System, Martin Dunitz Ltd., United Kingdom, 1989.

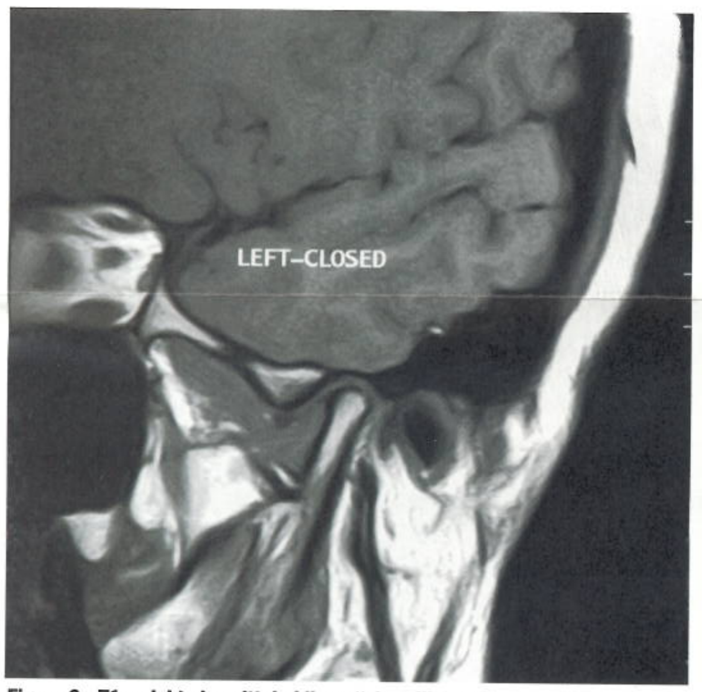


Figure 6 - T1-weighted sagittal oblique "closed" mouth, Seq = tse3_12b195.wkc, TR= 645 ms, TE = 12 ms, Flip = 180 deg, Slices = 14 (2 groups of 7), Thick = 3 mm, FOV = 130 mm, RecFOV = 8, DI = .10, Matrix = 192 x 256, Read OS, Phase OS = 41%, Acq = 6, Swap = no, Series = interleaved, Filter = F:9, Time =5:52 min.

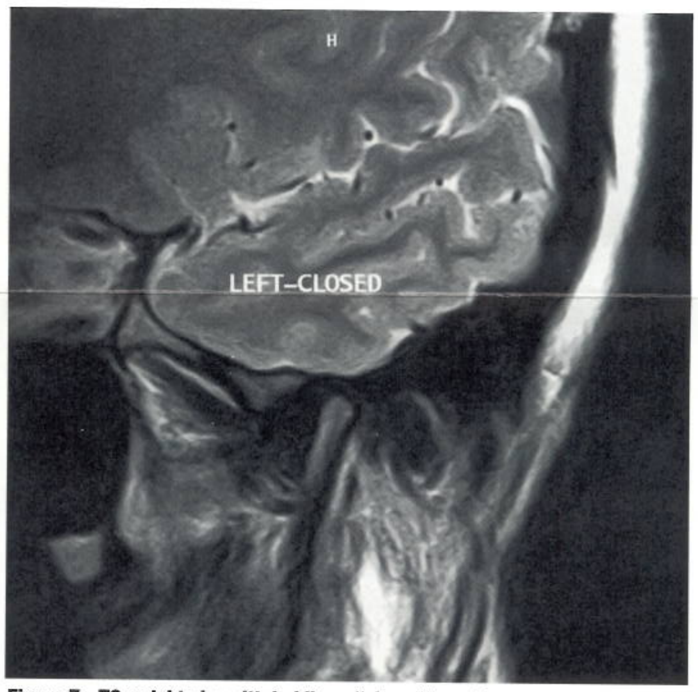


Figure 7 - T2-weighted sagittal oblique "closed" mouth, Seq = tse5_16b130_98b130.wkc, TR = 3000 ms, TE = 98 ms, Flip = 180 deg, Slices = 14 (2 groups of 7), Thick = 3 mm, FOV = 130 mm, RecFOV = 8, DI = .10, Matrix = 180 x 256, Read OS, Phase OS = 39%, Acq = 2, Swap = no, Series = interleaved, Filter = F:9, Time = 5:07 min.

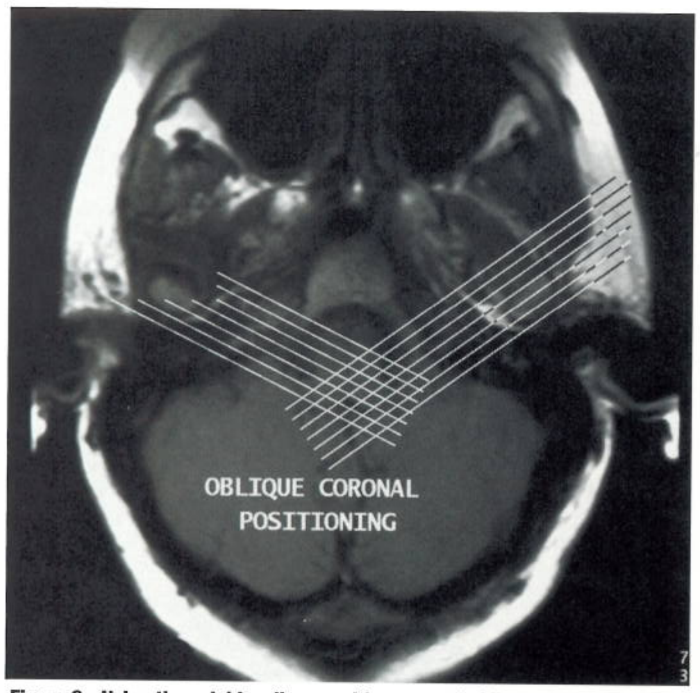


Figure 8 - Using the axial localizer, position coronal oblique slices parallel to horizontal axis of mandibular condyle.

Figure 9 - T1-weighted coronal oblique "closed" mouth, Seq = se_20b65.wkc, TR = 535 ms, TE = 20 ms, Flip = 90 deg, Slices = 14 (2 groups of 7), Thick = 3 mm, FOV = 130 mm, RecFOV = 6, DI = .10, Matrix = 96 x 256, Phase OS = 100%, Acq = 4, Swap = no, Series = interleaved, Filter = F:9, Time = 6:54 min.

APPLICATIONS TIP:

Matching T1 And T2 Slice Positions

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In our efforts to keep the TR quite short for some MR techniques which require very strong T1-weighting, we often need to acquire two smaller sets of T1 images which exactly match up to the same slice locations in a larger set of T2 images. I will describe a very easy way to match up the slices perfectly every time, requiring no more adding, subtracting, and multiplying to get those matching positions. This technique works for all MAGNETOM Open, Impact Basic, Impact Expert, and Vision systems.

1. Measurement/Set, Parameters, Exit. Rather than showing the selected protocol name in the sequence History, sequence parameters are being displayed.
2. Protocol/Select, choose and scan a T2 protocol with a large even number of slices (20, 22, etc).
3. Protocol/Select, choose the next T1 protocol.
4. Measurement/History, Slice Parameters, choose previous T2 protocol already scanned.
5. Protocol/Change, confirm number and location of T1 slices matches previous T2 slices.
6. Load T1 protocol, but do not scan (do not use Measure).
7. Free Slice, highlight lower half of the stack of T1 slices, Delete, Apply.
8. Protocol/Change, add FatSat or MT if needed, set minimum TR, Measure.
9. Measurement/History, Everything, choose previous T1 protocol loaded but not scanned.
10. Protocol/Change, confirm number and location of T1 slices matches previous T2 slices.
11. Free Slice, highlight upper half of the stack of T1 slices, Delete, Apply.
12. Protocol/Change, add FatSat or MT if needed, set minimum TR, Measure.

Hint: You may wish to use slightly different TR's on the two sets of T1 images (500 ms/501 ms) to help differentiate them later.

APPLICATIONS TIP:
Carotid MR Angio With The Large Body Coil On The MAGNETOM Open

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Technologists who work on the MAGNETOM Open sometimes come across patients scheduled for a carotid study who have a neck too large to fit into the multi-purpose coil. Recently I had such a patient with a large neck who was also too large to fit into a closed bore system.

I placed the Large Body Coil over the patient's neck, with her arms stuck out through the sides of the coil. Since the upper chest was so large, I removed the comfort pads and gave her an extra 2 inches of room; the coil was easily locked into place. I used the tracking presat sequence and the radiologists were very pleased with our results. Even though we slightly increased the FOV to 250 mm for extra signal, we were able to clearly demonstrate the right carotid stenosis.

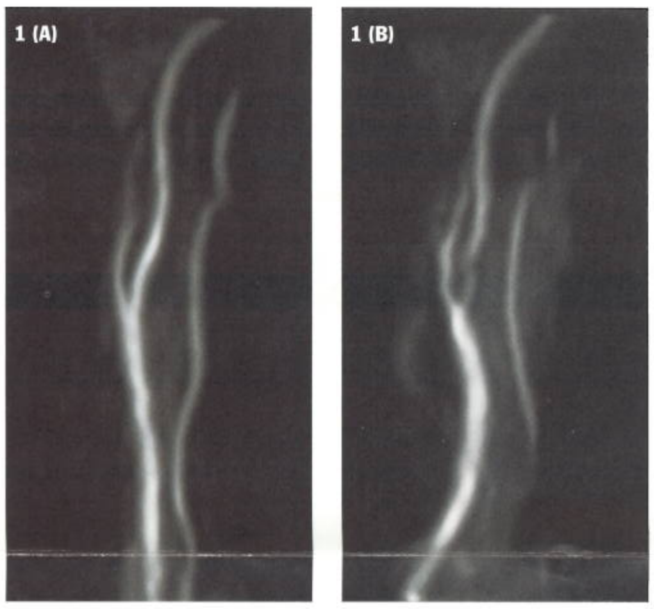

Figure 1 - (A) Normal left carotid. (B) Stenotic right carotid. Seq= fl2d_su_10rb78.uhc, TR= 80 ms, TE= 10 ms, Flip= 80, Orientation= tra, FOV= 250 mm, Matrix= 128 x 128,o , Thick= 5 mm, DI= -0.5, Acq= 1, Swap= no, Series= ascending, Interpolate= yes, Filter= F:5, Time= 10:21 min.

APPLICATIONS HOTLINE QUESTION:
False Line Artifact

RHONDA L. TURNER, B.S.R.T. (R)(MR),
TECHNICAL SUPPORT SPECIALIST
SIEMENS MEDICAL SYSTEMS, CARY, NC

We get quite a few calls on the MR Applications Hotline about a line artifact that does not rotate directions when the phase and frequency directions are swapped, but does change intensity and thickness with different pulse sequences, different coils, and different slice orientations. This line artifact does not go away with two acquisitions, but does appear very uniform (not speckled). It typically appears across the middle to bottom portions of a transverse view or a sagittal view.

Often after extensive troubleshooting by the technologist and/or field service engineer, this line artifact is determined to be caused by a yellowish, salty, pungent smelling fluid of bodily origin lying in the bottom of a certain coil, or the bottom of the table tray, or the bottom of a pad.

Can you guess what it is?

The best way to identify this situation is to note that a layer of fluid (blood, **urine**, gadolinium, etc) lying in the bore will not rotate directions if the phase and frequency directions are swapped, whereas most other types of line artifacts will typically rotate.

Another indication of this situation is to note that the signal intensity in the line artifact is quite uniform and probably wider than just one or two pixels. There is little chance that a line artifact from some other source will produce this appearance.

Also note that this line artifact will show up in all pulse sequences. Just like any fluid, it will be brighter on T2-weighted images and darker on T1-weighted images.

And finally, do not be fooled by changing the size or offcenter shift of the FOV, which may cause this line of fluid to be aliased to the other side of the image or may cause it to completely disappear.

APPLICATIONS HOTLINE QUESTION:
MSMA Anatomical Order

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Sometimes, images may come up in the incorrect anatomical order, particularly when scanning lumbar spines with the Multi Slice Multi Angle technique (MSMA). This technique is often used to acquire multiple groups of a few slices each, at different angles through different disk levels.

The incorrect anatomical order of the images is typically due to one of two user errors. First, the user may have saved an MSMA protocol with the groups out of order, ie., created an inferior disk level first and worked up from there, or jumped around from disk to disk when creating the groups. Second, the user decides to delete a particular group and recreate it with a different number of slices, putting the recreated group out of order.

To ensure that images come up in the correct anatomical order, delete and then recreate all groups in the correct anatomical order from superior to inferior at the approximate angle and location for an average sized patient, then save this setup again over the previously saved MSMA protocol. Thereafter, when using this protocol never delete any group, or change the number of slices in any group, or switch places between any groups when positioning them.

If you must delete or change any group, it is best to just delete them all and then recreate them all again in the correct anatomical order from superior to inferior. In this case, make sure not to go back and change anything within a group after it has been created (other than to slightly adjust its angle and location).

APPLICATIONS HOTLINE QUESTION:
Flow Void Artifacts

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We get quite a few calls on the MR Applications Hotline about flow void artifacts with Turbo Spin Echo (TSE) sequences, particularly in the cervical spine. TSE pulsing schemes are more sensitive to flow voids due to the multiple 180 degree RF pulses in the echo trains. This is the classic flow-related signal void due to in-plane flow and out-of-plane flow.

As with any multiple RF pulsing scheme, a bolus of flowing spins must experience all the RF pulses in order for the signal to be generated. The probability of this occurring is inherently reduced with a TSE technique since it requires many more 180 degree RF pulses than a conventional Spin Echo (SE) technique. The larger the echo train of the TSE sequence, the more improbable it becomes that a bolus of flowing spins is excited by all the RF pulses.

If the slice is thin and the excitation pulses have a low bandwidth, then in-plane/out-of-plane flow voids become more prevalent, even if the flow is predominantly in-plane. For example, even though the CSF flow may be predominantly in-plane for a midline sagittal slice through the cervical spine, the use of thin slices will probably cause some components of the CSF flow to be out-of-plane. This leads to localized regions of signal void that may mimic disease processes.

This is not a voxel dephasing phenomenon that is associated with spin dephasing due to flow and motion. Therefore, Gradient Moment Nulling (GMR) cannot be effective in reducing this artifact. Furthermore, if the out-of-plane component of flow is non-pulsatile, then ECG triggering cannot be effective.

Aside from using conventional SE techniques to avoid this problem, the most effective solution is to use a 3D TSE technique that will assure a large volume of excitation for all the RF pulses (a thick slab). However, the current implementation of this technique does not utilize GMR, so it will demonstrate CSF pulsatility artifacts in the highly pulsatile cervical region. As a note, the 3D TSE technique performs quite well in the lumbar spine region due to significantly less CSF pulsatility.

Reference 1 - J.A. Den Boer, A.R. Rozeboom, M.A. Van Buchem, J. Hosheimer, TSE Flow Voids In Transverse Spine Images And How To Avoid These: 3D TSE Or Thick Echo Temporo/Spatially Ordered Three Package MS TSE, 2nd Annual Meeting Of The Society of Magnetic Resonance, August, 1994, San Francisco, Vol. 3, p.1448.

Reference 2 - R.S. Hinks, R.T. Constable, Gradient Moment Nulling In Fast Spin Echo, Magnetic Resonance In Medicine, 32:698-706, 1994.

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