THE MAGNETOM

✸ FLASH ✸

newsletter for SIEMENS MAGNETOM users • vol. 1 no. 1/1993

IN THIS ISSUE

Why a Newsletter?

The mission of the MAGNETOM FLASH

Christine Harris, R.T.
Children's Hospital of Philadelphia

A short while back, I attended a meeting where we discussed the lack of technologists' attendance at organized educational meetings. The lecturers were all physicians. As the lecturers spoke, most of them referred to the technologist need to be knowledgeable and educated in MRI. The amount of knowledge and understanding can be related to the success of a facility in its technologists' ability to get certain difficult techniques to work. In fact, some facilities do not use certain techniques or do not use them to their fullest capability. Techniques that some of us use routinely, others do not use at all.

It crossed my mind that there should be a communication network between the Siemens technologist and the Siemens Corporation. Siemens has always recognized the importance of educating its technologists. And continuous education is even more important now in this ever-changing world of MR. Siemens has provided technologist meetings and sponsored technologists to attend major meetings. If we, as technologists could not attend these meetings, we were out of luck until the following year. I presume that in today's cost-efficient world there are many technologists that cannot attend meetings.

What then transpired was to suggest to Siemens the idea of a Newsletter. Siemens responded with an affirmative, and the MR Newsletter was born!

This is the first issue. In order for there to be more issues, we must all work together, communicate and contribute our ideas and suggestions. This new Newsletter is for you, the Siemens user. We want it to be informative and educational. Remember, we are our own source of knowledge. Let's share the information we know.

Siemens Quality Audit

MR Division
Siemens Medical Systems, Inc.

☑ SP/SP 4000
☐ Impact
☐ P8

Starting with Numaris A2.5, the Siemens Quality Audit Module will be offered. This provides a sophisticated level of self-diagnosis. Automated performance monitoring provides a detailed "fingerprint" of your system's operating characteristic ...with minimal effort from you. As explained below, you may start the module yourself or have it activated remotely; either way, it runs overnight, during off hours.

From the measued data, a trend analysis is made to evaluate your system's "fingerprint" to track performance trends, assuring the day-to-day consistency of high-quality imaging for you. At the same time, it identifies components that may be candidates for replacement during your next planned

How the Siemens Quality Audit Works:

Your part is simple:

❶

Select a day and time each week when it is convenient for you to allow the system to perform its self-checks. After the last patient has been imaged, place the appropriate phantom in the magnet and press one button to enable the Quality Audit Module. That's all you do! The rest is automatic.

We do the rest:

❷

At the pre-selected time, the Audit is initiated automatically. Several key parameters of your system's performance are measured and recorded in your systems "fingerprint" for use in later analysis. If you prefer, your Siemens field service engineer will activate the Audit remotely at the specified time.

❸

Siemens trained service personnel evaluate your system's "fingerprint", using a worldwide database to track emerging trends and identify components that may require attention. If warrented, they recommend equipment recalibration or possible component replacement.

❹

Your Siemens service engineer then follows up on these recommendations to insure the continued reliability and high image quality of your MAGNETOM.

Please consult your user's manual for more details on this program.

Siemens proactive approach keeps our finger on the pulse of your MAGNETOM, maximizing your image quality and avoiding interruption to your clinical routine.

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Clinical Focus: Knee Imaging

MR Imaging the Anterior Cruciate Ligament of the Knee

- ☑ SP/SP 4000
- ☑ Impact
- ☑ P8

Brian Murphy, M.D., Doctor's Hospital of Coral Gables

The anterior cruciate ligament (ACL) is a primary central stabilizing ligament in the knee. It is comprised of two bundles of fiber which attach to the anterior aspect of the tibial plateau and course posteriorly and superior into the intercondular notch to attach to the medial aspect of the lateral femoral condyl. This ligament prevents excessive anterior translation of the tibia with respect to the femur and also provides a central rotational axis for the knee.

Ideally, imaging of this small structure would be performed along its longest axis, parallel to its fibers. Traditionally, it's been stated that a 10-20 degree externally rotated knee will place the ACL in profile, so when sagittals are prescribed, there is a high probability to obtain good images of this structure. However, this still remains an "educated guess work", you may get it, you may not. Another approach is to line-up oblique slices on axial images (on medial aspect of lateral femoral condyle), again it still remains less than 100% accurate.

What has worked for us, is a method of visualizing the ACL on the coronal views and aligning oblique sagittals along its axis.

First, it is necessary to obtain "true coronals" this is, to position the knee not externally rotated, but as straight as possible - neutral. If, however, on the axial localizers the knee is rotated, we proceed to oblique the coronals along the axis of the condyles so as to obtain "true coronal views". This is a first and most important step. You will not get a good ACL if this is not followed and it will appear somewhat foreshortened if taken from a less than true coronal.

The second step is to page through the coronals and find the ACL — on the medial aspect of the lateral femoral condyle and follow it through on more than one coronal image.

Selecting a double echo sequence we are able to create different groups, the first two should be vertical, orthogonal. Each group is of seven slices with a gap of 10-20%, positioned on each meniscus (lateral and medial), then a third group of four slices with 0 gap vertical, oblique and position this group aligned with the course of the ACL on the "true coronal views".

Advantages:

a. Obtain consistently ACL views T2-weighted (more specific to determine complete vs. partial ACL tears).

b. Avoid having to run two separate sets of T2s (a separate oblique through the ACL).

c. An easy and consistent method to reproduce, helpful in centers with several MR technologists.

d. Reduces partial volume averaging which increases visualization of true signal abnormalities in the ACL.

Disadvantages:

a. If you oblique the coronals, the resulting sagittals will be double obliqued, display slice will not be supported. You may do a copy/seg store at the time of the set-up.

b. There will be some crosstalk because of the overlapping of the oblique and straight groups. You may run these interleaved and because crosstalk in T2 images with a fairly long TR is less critical than T1, this is not a significant problem.

c. The PCL and quadriceps might be missed with the oblique cuts. We obtain T1 weighted straight cuts to evaluate menisci, etc. If a PCL/quadriceps injury is suspected, we then proceed with T2-weighted sagittals acquired straight.

d. When doing left knees. The order of slices is altered. You will need to do a study/arrange by TE, then film them by selecting the study. There is no problem with right knees.

The presence of any intact taut fibers on any pulse sequence excludes a complete ligament tear. Some untorn ligaments will exhibit increased intensity in the older populations; however, some intact, taut fibers will be present. Angled ACL T2 images are usually most helpful in conjunction with the T1 coronals in differentiating partial from complete tears. Also, bone contusion sites (low intensity on T1, high on T2) in the mid to anterior lateral femoral condyle and in the posterolateral tibial plateau are frequently present with complete ACL tears and are not usually seen with tears which are only partial.

Technique:

Seq: SE_25B56_70B56 (1.0T)

Seq: SE_20B78_55B78 (1.5T)

TR=2300	Th=4mm
TE=25/70-80 (1.0T)	Gap=10-20%/0
TE=20/75-80 (1.5T)	Acq=2
Mx=192 x 256	Swap=YES
FOV=160	Filter=Fermi(weak)

SATpulse=1 TRA (th=40mm, shift=-100)

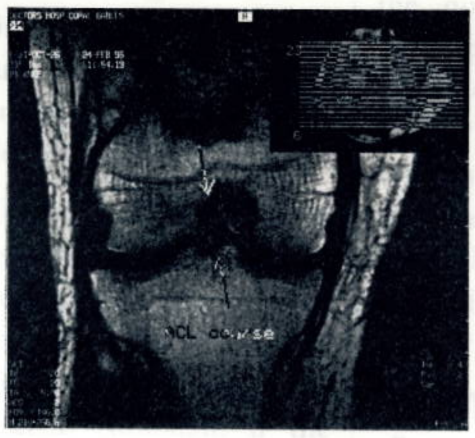


Figure 1

Figure 2

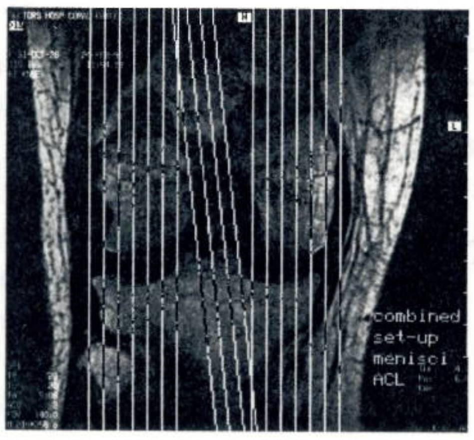


Figure 3

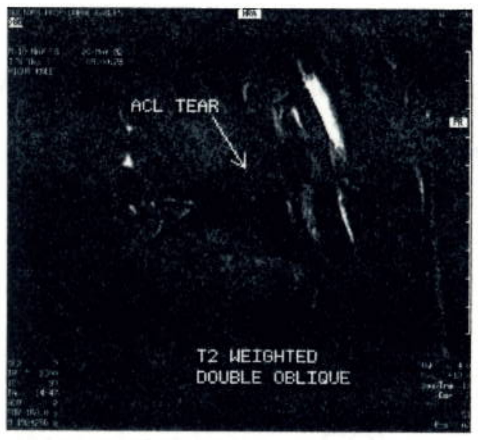


Figure 4

Figure 1 – T1-weighted coronal showing the course of the ACL. Note the set-up of the slices on an axial localizer of an externally rotated knee.

Figure 2 – T1-weighted sagittal image acquired straight.

Figure 3 – Combined set-up for menisci and ACL. This set-up requires the placement of three groups of slices.

Figure 4 – T2-weighted image acquired double oblique

New Neuro Sequences:

☑ SP/SP 4000
☐ Impact
☐ P8

Gary McNeal, Siemens Medical Systems

When using a relatively small recfov for sagittal T2 spine imaging, it becomes necessary to also use a posterior phase offset in order to center the spine within the recfov (to avoid wrap in the phase direction). However, in order to perform an offcenter shift, the bandwidths on both echoes must be equal. In A2.3 there were several sequences possible for this, but none of them combined *all* the ideal attributes for this application.

SE_20B78_90RB78 has equal low bandwidths for good snr, and has short first TE for strong proton density weighting, but no gmr on first TE which is essential to eliminate csf pulsations in spine imaging.

SE_45RB78_90RB78 has gmr on both echoes, equal low bandwidths, but the first TE is too long for proton density weighting.

SE25B56_80RB56 has no gmr on first TE and the bandwidths are too low for *1.5T.* imaging.

HIQ SE20RB130_80RB45 and SE_12B130_80RB45 (and their 1.5T counterparts) have unequal bandwidths, and besides the bandwidths on the first TE are way too high for neuro imaging (thus the proton density images were horribly noisy).

So, the new sequence SE_27RB78_81RB78 has it all, as I requested:

1. Low bandwidths on both echoes for good snr, but not too low for 1.5T.
2. Equal bandwidths on both echoes for offcenter fov.
3. GMR in slice & readout directions on both echoes for csf pulsations.
4. First TE less than 30ms for acceptable proton density weighting.
5. Second TE 80ms for acceptable T2 weighting with better snr than 90ms.
6. Ernst angle available for optimizing T2 contrast of second echo.
7. GMR in the phase encoding direction on the second echo to further reduce csf pulsations in the T2 sagittal c-spine.

So, let's try this new tool for those cases when TurboSE and Flash2d are not used because conventional spin echo is demanded.

Protocol
SE_27RB78_80RB78,
TR=2200, TE=27/81,
Flip Angle = 65
Number of Slices = 11
Thickness = 4
Distance Factor = 0.2
Matrix = 128x256,o
RECFOV=5/8
OFFCENTER PHASE = -30mm (approximately)
Acquisitions = 2
Field-of-View = 260mm
SWAP=no
PRESAT = 1, anterior

Future Articles

If you have any suggestions for future issues, please forward them to us. We will try to include them in future issues.

Scanner Names

We all have names for our scanners. What's yours? Send us those names. We will print them in the next issue.

Send all correspondence to:

Siemens Medical Systems
P.O. Box 9264
Philadelphia, PA 19139

Voxel and Pixel – Do you really understand them?

Tamara Lee, R.T.
Central MRI, Linwood, NJ

☑ SP/SP 4000
☑ Impact
☑ P8

In the formation of an MR image, there are two concepts; voxel and pixel, which contribute to the display of a digital image.

A voxel is a volume element, or three-dimensional version of a pixel. In an image, a voxel is represented on the CRT screen or on a film, by a two-dimensional representation, or a pixel. An array of voxels or pixels forms the image. The voxel and pixel are determined by the matrix size along two dimensions (frequency and phase) and by slice thickness along the third dimension. The size of the voxel determines the amount of signal in the MR image, because more tissue in the image means more signal in the image. This signal then appears as a certain intensity value in the image. The terms voxel and pixel are used interchangeably, although they do significantly different things.

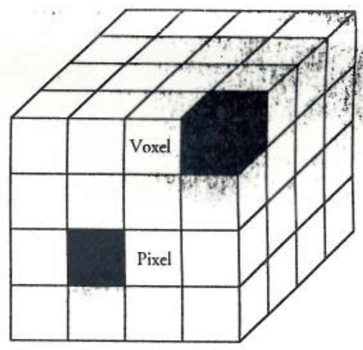
Voxels contribute to image quality in more than one way. Voxels not only contribute signal to the image, they also contribute spatial resolution. The size of the voxel or pixel determines the amount of sharpness or edge definition in an MR image. Images with small voxels sharpen the appearance of anatomic structures, but these images are noisier than images with large voxels. While it is desirable to minimize the noise and blur, it is possible that a compromise between the two needs can be reached.

While decreasing the size of the voxel reduces the strength of the MR signal in each voxel, the amount of noise in each voxel is not affected. Although, if the signal is significantly less, it may seem there is more noise.

The spatial resolution in an MR image depends solely on the size of the voxel. Although spatial resolution is independent of signal to noise, if the signal is significantly less, the image seems to have an abundance of noise. If there is too much noise in an image, the spatial resolution can be compromised to the point that the image is not diagnostic.

A pixel is th esmallest discrete part of a digital image dilay. The size of each pixel determines the spatial resolution of an image. Pixels are stored as numbers ina computer file. The number assigned to each pixel represents the strength of the MR signal emitted at the particular location. The numbers are converted to a shade of gray by the analog to digital converter. Higher signal intensities mean brighter shades of gray and the converse is also true.

The size of the MR image is determined by the FOV of the image. The resolution of an MR image is determined by the number and size of the pixels in the image. More pixels means higher resolution. The most frequently used MR image consists of 256 pixels in columns and 256 pixels in a row. When determining the trade-off for resolution and signal-to-noise in an image, it is also important to remember that there is a time factor involved. In an image with a 256 x 256 matrix, there are 256 frequency steps, which do not affect the length of image collection. But, the 256 phase steps do affect the time of image collection. The higher the phase steps, the longer the imaging time.



Seminars and Announcements

Know of any conferences coming up? Let us know. Give name, date, place, contact person and phone number as well as a brief description of the course.

Here is a list of Siemens Magnetom Users' Meetings in 1993:

January 30	Atlanta Marriott Marquis
March 28	San Francisco (SMRM)
March 6-13	MR Conference (Steamboat Springs, CO)
April 15-17	Technologist Seminar Hilton Riverside, New Orleans
May 15	Vancouver (ASNR)
July 31	Laguna Nigel, CA Ritz Carlton Hotel
September	Seattle, WA
September	Technologist Seminar, Arizona

Application Tips

The Application Tips section is the portion of the newsletter that gives you the opportunity to share helpful hints and tips with other Siemens System operators. If you have an application tip you think would be helpful to another Siemens System user, please write it down and send it to us...we will then select tips for our next issue.

Apps Tip 1

A Great T1 Axial Thoracic Spine Sequence

- ☑ SP/SP 4000
- ☑ Impact
- ☐ P8

Protocol

SE_20B78
TR = 650, TE = 20
Num. of Slices = +/-12
Field-of-View = 500mm
Thickness = 5mm
Orientation = Transverse
Distance Factor = 0.2
Slice Series = Interleaved
Matrix = 420 x 512,o
Num. of Acq. = 2
Filter = Fermi(w)
SWAP = yes
Mag. Factor = 3.0

2 SATs placed obliquely (forms a teepee over the spine when prescribed on an axial reference image).

This yields a no-phase-wrap technique where respiratory motion goes left-right rather than anterior-posterior, and the presats really clean up respiratory motion anyhow.

Also try this same technique in the T1 axial lumbar, except use no presats and take extra slices.

Apps Tip 2

Errors in A2.5 Applications Guide

- ☑ SP/SP 4000
- ☐ Impact
- ☐ P8

Please note the following two errors in the A2.5 application guide:

1. A2.5 Aps. guide, page 1:29, RECFOV, all entries under column titled "relative pixel size" should be 1:1 (isotropic resolution).
2. A2.5 TurboSE Aps Guide, page 1:20, Turbo Spin Echo sequence listed with B130 should be listed with B195.

Apps Tip 3

RF Blanket Transmitter Problem Solved

- ☐ SP/SP 4000
- ☑ Impact
- ☐ P8

RF problem for knee imaging resolved. For those Impact users that have been experiencing RF problems with (coronal) knee imaging while using the RF blanket, there is good news: the problem has been investigated and resolved. A software patch (modification 193) is or will be installed on your system. If you are still experiencing problems, please contact your local field service engineer.

Apps Tip 4

MR Applications Support Line Announced

- ☑ SP/SP 4000
- ☑ Impact
- ☑ P8

In Siemens' effort to help you in your daily clinical routine, Siemens is happy to announce the new MR Applications Support Line.

You may call toll free!

MR Applications Support Line:

1-800-333-3137.

Monday - Friday

9:00 AM to 6:00 PM (est).

Questions & Answers

The Question and Answer column is the section of the newsletter designed to benefit all Siemens users by the questions asked by a few. Do you have any questions for Siemens? Write them down and send them to us even if you think the question has an easy answer. If you do not know the answer, then this is the place you can find one. Your question and the response will appear in the next issue.

Books and Articles

If you have articles or books that have been especially helpful, why not take a minute and jot down the title. author and additional information and submit it to us. We will be sure to pass on this information.

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