

McGill University
Department of Diagnostic Radiology
MR Imaging Fellowship

THIS FELLOWSHIP IS OFFERED TO EXTERNALLY FUNDED CANDIDATES AS WELL AS QUEBEC GRADUATES FUNDED BY RAMQ.

Duration of training: 1 YEAR

Number of positions: 1

Name of Fellowship Director: Dr Caroline Reinhold

Name of Program Director: Dr. Jeffrey Chankowsky

The MRI fellowship consists of body MRI (chest, abdomen and pelvis), and musculoskeletal MRI. Six months in each specialty.

MR IMAGING SCHEDULE

Body MR imaging

Monday,	7:00 – 11:00 A.M. ; 3:00 – 7:00 P.M.(every second week)
Tuesday	7:00- 3:00 PM
Wednesday	7:00-11:00 A.M.
Friday	7:00-11:00 AM

Approximately 20-25 body MR scans are currently performed per week. The fellow is required to be present in the scan room during scanning times as outlined on the schedule above. MRI, similarly to US, requires active physician presence while the data is being acquired (see monitoring cases below). In addition, by watching the technologists program the sequences, the fellow will increase his/her familiarity with the various scanning parameters, learn ways to decrease scanning time, improve resolution etc. Because of the discontinuous schedule due to MR body slots being spread throughout the week, MR fellows will be asked to cover Bone or Neuro MR during times when body MR is not running. Alternatively, the fellow may choose to spend these slots in cross-sectional abdominal imaging and nonvascular intervention.

Head and neck cases are imaged by CT and MRI modalities which, as in the neuro cases, are closely supervised by an experienced ENT radiologist

Musculoskeletal MR imaging

The Radiology assessment of bone, joint and soft tissues pathology is a significant part of the Radiology Department. It is particularly important at the Montreal General Hospital where the Department of Orthopaedics, Rheumatology and Emergency Medicine are very active and dynamic and where there is a large daily patient load. There is usually at least one resident doing a monthly rotation in Musculoskeletal Radiology. In addition, there is a Bone fellow involved in many facets of Musculoskeletal Imaging including plain films, arthrography, CT, MRI, US and Bone biopsies.

McGill is the referral site for soft tissue sarcomas for much of Eastern Canada.

Approximately 50 musculoskeletal MR cases are performed every week. Most of these studies are done unmonitored during evening and weekend hours. Every week monitored slots are available from 7AM - 11 AM on Mondays, and 11 AM – 3PM on Fridays. These slots are reserved for cases requiring gadolinium injection and MR arthrography.

The MR fellow is in charge of screening the patient for possible hazards, monitoring the case including adaptation of the standard protocols to the need of a particular pathology, reporting and maintaining order. The MR interpretation sessions are concentrated particularly on Mondays and Fridays, however, are also held throughout the week.

MRI ROTATION OBJECTIVES

1. Know contraindications to MR imaging.
2. Know indications for MR imaging.
3. Be familiar with basic pulse sequences and their clinical applications.
4. Be familiar with basic imaging artifacts.
5. Recognize the normal anatomy in the various imaging planes, and with various pulse sequences.
6. Recognize pathology and be able to discuss the signal characteristics of commonly seen pathology.

MRI FELLOW RESPONSIBILITIES

1. Screen and interview patients prior to scan.
2. Review cases scheduled for next day, including indications, pertinent plain films, CT, US etc. and imaging protocols.
3. Monitor studies.
4. Organize cases for readout.
5. Contribute to teaching file.

1. Screening patients:

All patients are screened 3 times before entering the MRI unit if possible. A patient questionnaire is completed by the referring physician in conjunction with the patient and is sent to our department with the requisition. This form must be reviewed prior to scheduling the patient to ensure that no contraindications to MR scanning exist. Immediately before the technician screens the patient prior to entering the MR scanner, it would be prudent to review the patient questionnaire with the patient. At the same time the patient can be interviewed to obtain a history pertinent to the exam. This information can be written on the MR requisition. A list of implants etc. and their potential hazard to MR imaging is available in the MR scanning room and can be consulted when necessary.

The following are a number of guidelines to commonly encountered problems and hazards but is by no means a complete list of contraindications to MR imaging:

Common hazards:

- a. History of metal work: If the patient always wore safety glasses and never had an injury to the eye, then this should be indicated on the patient questionnaire and no further evaluation is necessary. If the patient never worked with ferromagnetic metals, this should be indicated on the questionnaire. In these cases no orbit films are necessary. In all other cases orbit films should be obtained. Request Caldwell and lateral views. If no densities are seen on the orbit films one can proceed with the study. Often small densities are present on the films due to dust on the cassettes. The patients must be sent back for repeat orbit films and it is often helpful to call the technologists to tell them why you need to repeat the exam.
- b. Cardiac surgery: Pacer wires left in at the time of surgery are the most common cause for a possible hazard. (All heart valves are MR safe except the Starr Edwards Pre 6000). A chest film should be reviewed to make certain temporary pacer wires were not left in place.
- c. Brain aneurysm clip: Cannot be scanned unless type is known as some are an absolute contraindication.
- d. Metallic foreign body injury: Bullets are made of lead and therefore are generally safe. Shrapnel, shot and bb's are ferromagnetic and therefore a potential risk depending on size and location. These cases should be discussed with the attending.
- e. Pregnancy: "The safety of MR imaging when used to image the fetus has not been established" by the FDA. Any pregnant patient should not be scanned unless the case has been discussed with both the referring attending and the MR

attending. Informed written consent must be obtained from any pregnant patient (use procedure/surgery consent forms). It is generally prudent to have the referring physician discuss with the patients the FDA status of MRI and that informed consent will be obtained before the patient arrives in MRI. In general MR examinations are avoided in the first trimester unless there is no alternative imaging modality and the examination cannot be postponed to after the first trimester. Any pregnant patient scanned should be scanned with each sequence using the lowest SAR possible. A general guideline is to keep the value below 0.4 watts/kg if possible. The value can be lowered for a sequence by increasing TR, decreasing the number of slices obtained, and by avoiding the use of SAT pulses. *Gadolinium* should not be administered to a pregnant patient under any circumstances.

- f. Lens implants for cataracts are not a contraindication to MR imaging.

2. Review requisitions for the following day:

Requisitions for patients scheduled the following day should be reviewed the afternoon prior to the patients exam (preferably before 5 PM so referring physicians can be contacted if necessary). The requisitions of patients scheduled are kept at the CT/MR reception desk as well as the completed patient questionnaires. If there are any questions regarding safety, these should be resolved at this time (e.g. If the patient worked as a metal worker and has had orbital films these need to be checked, or if they need to be done the patients should come in early etc.)

The requisitions should then be reviewed. These will have been screened by a MR attending prior to scheduling the patient, however, the indications should be clear in your mind. If the indication for the exam is unclear or there are other questions, the referring physician should be called or your concerns should be discussed with the MR attending, preferably the attending who will be covering the cases the next day. When the requisition is reviewed, previous pertinent reports should be consulted, as well, all pertinent previous images must be reviewed. Pertinent previous reports are printed out by the MR secretaries.

3. Monitor studies:

Monitoring cases involves making decisions on what sequences are necessary to delineate the possible pathology. On each pulse sequence one needs to make four basic decisions.

1. Imaging plane to best delineate the pathology (i.e. axial, coronal, sagittal, or oblique).

2. Slice locations necessary to cover the pathology (this includes decisions on slice thickness, interslice gap, field of view, center of FOV. The most important concept to keep in mind is that one should scan through the full extent of any pathology present.
3. Pulse sequence parameters to best delineate the pathology. This includes decisions as to the type of sequence (spin echo, gradient echo, inversion recovery), imaging timing parameters (TR/TE), imaging artifact reduction techniques (flow comp, gating, sat pulses, no phase wrap, resp comp, etc.).
4. Patient and hardware decisions. These include decisions on use of surface coils, need for buscopan, patient position modification, adjustment of resp, comp, belt etc.

Protocols on various organs and specific pathology (pancreas protocol, single lesion liver protocol, multiple lesion liver protocol etc.) are available and have been programmed into our MR system. However, each patient and pathology is slightly different and frequently the protocols are altered "on the spot" to best delineate the particular pathology present. Also due to time constraints, not all sequences in the protocol may be feasible and therefore a decision as to the most "cost-effective" sequence must be made. Although the technologist usually preps the patient, and injects the antispasmodics and contrast medium, you may be asked to place an IV line, and/or administer these agents if the technologists are short-staffed or busy preparing the next patient.

4. Organize cases for readout:

The information necessary to read out a case is usually obtained in reviewing the next day cases and in interviewing the patients. Occasionally other information will be necessary, for instance prior films may need to be obtained from a physician or an outside department.

It is the fellow's responsibility to ensure that all pertinent previous studies and reports are available at the time of the readout sessions. In addition to previous plain films, US and CTs, this includes ERCP reports and films in the case of MRCP studies. Auto-routing of prior CT scans to the MR workstation takes place once the patient's name is entered into the MR scanner. US studies will be routed to the e-film workstations. If for some reason the previous studies are not available, these should be transferred to the appropriate workstations from Netscape prior to the readout session with the MR attendings.

5. Consult with clinicians:

Assist and teach residents (radiology and other specialists). Help consultants in accessing cases on workstations

6. Contribute to teaching files:

All interesting cases are entered into the Teaching File component of the PACS. It is most efficient to do the teaching files immediately.

7. Rounds :

Abdominal rounds

The resident on the MR rotation is expected to attend the abdominal rounds beginning at 5:00PM on a daily basis and bring the interesting MR cases and correlative studies (CT / US tapes).

Neuroradiology rounds

Monday	08 ;30 – 09:30	Combined,Neurology, Neuropathology, Neuroradiology Rounds.
Friday	12:00 - 13:00	Neuroradiology weekly rounds for radiology residents

Musculoskeletal rounds

Rheumatology rounds

Orthopaedics rounds

Bone and soft tissue tumor rounds

Bone conference

Bone Club.

8. Research

There is ample opportunity for those interested in MR imaging research to conduct one or more research protocols. All fellows are encouraged to undertake at least one research project during their year of fellowship. Fellows actively involved in research may be given 0.5 to 1 day of protected academic time during the week. Research topics include body MR imaging, musculoskeletal MR imaging, head and spine trauma, emergency radiology, interactive teaching, and the use of computers. A large section of physicists specialized in medical imaging and a solid engineering department are attached to the radiology department.

10. Emergencies:

If there is an accidental quench of the magnet (liquid helium and nitrogen become vaporized), remove the patient immediately from the scan room and close the door. The nitrogen can displace the oxygen in the room resulting in life threatening hypoxia.

NEVER deliberately quench the magnet unless a life is threatened with the patient being pinned against the magnet by a ferromagnetic object.

READING / STUDYING LIST

Body MR

1. MR imaging of the abdomen – A Text Atlas by Semelka, Ascher, Reinhold. A copy is available through our Radiology library.
2. Magnetic Resonance imaging of the body by Higgins, Hricak and Helms. A copy is available in the department, but should not be taken home. Physics section is also good to read through.
3. MRI text by Stark and Bradley. The physics section is rather detailed and difficult to cover unless you understand the basics well. The body MR section is good.
4. GE manuals. Can be obtained from the MR chief technician, Lori Rohoman. Can be photocopied for reading at home.
5. Questions and answers on MRI. A small soft cover book that covers basic MRI physics. Can be borrowed from Dr. Reinhold
6. Selected articles. These articles must be read on site and should not leave the department, they must be returned every evening to Dr. Reinhold.
7. RSNA exhibits on CD ROM dedicated to MRI.

Musculoskeletal MR

1. Bone and Joint Imaging - Resnick
2. MRI and CT of the Musculoskeletal system - Firooznia
3. MRI in Sports Medicine - Stohler
4. Radiology of Bone disease - Greenfield
5. Musculoskeletal US - Van Holsbeeck
6. Orthopedic pathology - Greenspan

ON CALL

The fellows rotate on the US/CT on-call list as junior staff. They are on-call, at home with a pager, and are a resource person for the residents on-call. Their expertise may be requested for ultrasound, CT cases or interventional procedures. Whenever they are requested to perform a procedure, they must contact one of the staff radiologists who routinely rotate in intervention prior to performing the procedure.

VACATION/CONFERENCES

The fellow is granted 4 weeks of vacation plus an additional week during either the Christmas or New Year's holidays. The fellow is also granted one week to attend a conference if he/she wished to do so. If he/she presents a paper at a major conference, the time of the conference is not counted against his/her conference or vacation time. In addition, he/she may request funding for expenses incurred to attend the meeting where he/she presents, provided that the research was done in the department of Radiology at McGill University.

FELLOW EVALUATION:

The fellow is evaluated on a daily basis by the attending staff and will meet regularly with the fellowship supervisor for face-to-face feedback. A formal written evaluation is completed every six months, using the CanMEDS roles scheme.

EXPECTED CASE LOAD (daily)

Body MRI: 6 cases/day

MSK MRI: 15 cases/day

Academic Facilities

- Internet access from all workstations and from fellow's office
- Access to libraries at MGH, RVH and McGill
- Multimedia learning materials available
- Free online journal access via McGill portal

The fellow's responsibilities are separate from those of the residents, and the fellows positively impact residency training. There is no negative impact of the fellowship on residency training.