

## **MRI Research Technologist (Technologist)**

### **Specific Skills, Knowledge and Abilities**

#### **Project preparations prior to subject arrival**

The Technologist shall meet with each principal investigator to discuss particular aspects of their MRI project protocol. He/She shall work with the principal investigator and graduate students, etc. to prepare the system for the protocol. This may include evaluating and optimizing pulse sequences or different combinations of pulse sequence parameters. It may include setting up ancillary equipment and software, such as the stimulus presentation software and stimulus paradigms, that are run at the same time as the scan. Protocols and procedures for the project shall be setup in the MRI system software, and the step-by-step procedures to carry out the protocol shall be documented in a electronic file and hardcopy. He/She shall maintain a book of the step-by-step procedures for each protocol, so that other trained individuals could run the protocol, or learn from the protocol.

#### **Patient/subject interaction**

The Technologist shall have skill in greeting the patient or subject (collectively referred to as patients) and helping them to feel comfortable in the scanning environment. He will follow guidelines of courtesy as described in the attachment, "Patient Services".

#### **Patient screening and scan preparation**

The Technologist will 1. screen patients for possible contraindications to MRI, and assist patient in completing the pre-MRI screening questionnaire, if not already completed by patient; 2. verify that the patient has a basic understanding of the procedure, and answer any questions; 3. position patients for study using the correct anatomical reference points; 4. communicate with the principal investigator as needed to confirm selection of the correct MRI protocol and any adjustments to scanning parameters; 5. monitor patients during scanning using direct viewing and closed circuit TV monitors as available, and never leave patient unattended during scanning; 6. insure that adequate images have been obtained, and when necessary, review images with the principal investigator, before dismissing the patient.

#### **Animal imaging**

The Technologist will be required to perform scanning of sedated animals in the same way that he/she performs them for patient studies. However, he/she will not be required to directly handle the animals. Principal investigator shall provide sufficient trained staff to handle all aspects of animal preparation, placement, monitoring, control and removal of the animal through the scanning session. Principal investigator and trained staff must have specific knowledge of MRI safety precautions and procedures, and prepare themselves (e.g. clothing) and the animal in accordance with these precautions.

## **MRI scanning**

The Technologist shall become expert on the operation of the MRI systems for scanning patients and subjects with commercial pulse sequences purchased with the system. He/She shall become expert in the biomedical applications of the various pulse sequences. He/She will become expert in all pulse sequence options and their application to improve image quality.

The Technologist shall become expert in the application of special imaging options, so that they can be explained to the principal investigators, incorporated into the research design of these investigators, and used at any time. The MRI systems will include several imaging options that improve and expand the performance of the system. For example, the systems may include real-time image display, and real-time scan parameter changes. These features are difficult to understand and use.

The Technologist shall be able to test research pulse sequences, following procedures developed by himself and or by an MRI physicist. He/She shall be proficient in the evaluation and optimization of pulse sequences for particular applications, following procedures developed by himself and or by an MRI physicist.

The Technologist shall complete the “special procedures” of research studies, throughout the duration of the study. He/She will perform IV contrast injections as needed, if he/she possesses the required certifications. Clinical research, in particular those studies involving a Reading Center that collects images from multiple MRI sites, often requires numerous special procedures. For example, such studies have special forms for documenting that each scanning session was performed, and the images archived and shipped to the Reading Center. They have special forms for recording scan progress (time of each scan) and noting problems during the scan such as patient motion. The study procedures often require that image quality and patient alignment be evaluated with stringent criteria, and scans repeated if the criteria are not met. Usually, both electronic copies and hardcopies of the images are required with very specific header information and formats, and the paperwork necessary to ship the images (hardcopies and electronic versions) to the Reading Centers is extensive.

The Technologist will follow general and specific instructions on the safe use of the MRI system, as detailed in the Vendor User’s manuals and safety documents included in this Binder, including following of proper shutdown and boot procedures for all components of the MRI system and accessory equipment.

## **MRI Scheduling**

The Technologist will have access to the scheduling system ([calendar.netscape.com](http://calendar.netscape.com)), and shall resolve schedule conflicts.

## **MRI Image Analysis**

The Technologist shall become expert in the use of software tools and options that exist on the MRI system, so that they can be demonstrated to the principal investigators and used routinely in research studies. He/She shall make each principal investigator aware of these tools, so that these investigators can incorporate them into their research protocols. The operating software of the MRI system, with options, typically provides a wide range

of image analysis tools. Many of these tools are considered advanced processing techniques for 3D and 3D time-resolved data sets.

## **MRI Training**

The Technologist shall provide hands-on training, and lecture-based training on the operation of the MRI system. He will give the formal Training Course developed by the Technical Director. The intended audience of these lectures and hands-on sessions will be graduate students, post-docs, faculty and staff that are involved in research utilizing the MRI systems. He/She shall administer examinations to course attendees. Attendees that pass the examinations will be authorized to operate the MRI system without immediate technologist support.

## **“Novice operator” supervision**

The Technologist shall be generally available to assist novice operators of the MRI systems when the system does not respond as expected, and the operator is unable to continue scanning. Novice operators are defined as those that have had sufficient training and have been granted “Level 1” authorization (see Read me Summary), but are relatively new to operating the MRI system. He/She will coordinate with other scanning experts (e.g. physicists, senior technical graduate students) so there is consistent availability to deal with problems the novice operates may have.

## **Data Transfer and storage**

The Technologist shall be able to work on a wide range of computer hardware and operating systems, including Windows, SGI IRIX, Linux, and other Unix platforms such as Sun. He/She shall be able to install and use various programs for transferring image files between the MRI system and various research computers. For example, installation, testing and routine use software for DICOM image transfers may be required, in order to effectively move data from the MRI system to research systems. He/She shall provide information to GE service to configure the MRI systems for image transfers to various research computers, and the Radiology PACS systems if required.

The Technologist shall use available software programs on the offline workstations (SGI) to transfer raw data or images from the MRI system, reconstruct the raw data into images, and place the resulting images into an organized database. He/She will develop procedures for transferring the images to the principal investigators’ computers, in particular, he/she will write software scripts to automate the transfer of the raw or image data as much as possible.

The Technologist will record all MRI studies in the MRI Scanning Logbooks, maintain archive copies of all studies on optical disks or other media available on the MRI system, and retrieve MRI studies from the optical disks when required. He/She will arrange for image filming through the Hospital facility, involving transfer of the images to the Hospital MRI system, followed by film processing by one of the Hospital MRI technologists.

## **Data Analysis (Image Reconstruction and Post-processing)**

The Technologist shall run the customized image reconstruction software that is part of the Research Imaging Center on an as needed basis. He/She shall learn to run the various post-processing software, so that the processed image data or extracted information desired by the principal investigator is provided. He/She shall create the information text files that are needed by some reconstruction and analysis programs.

## **Database Management**

The Technologist shall organize images from different studies and scanning sessions into an image database. The database might be one using a specific 3<sup>rd</sup> party software, or be a simple database based upon the directory structure of the operating system's file system.

## **Software management**

The Technologist will install and maintain third party software on the research computers in the Imaging Center. Third-party software will play a role in a broad range of research activities (e.g. raw data transfer, image analysis, and presentation preparations). This work will be part of the duties of the Computer Systems administrator, once that person is hired.

## **Programming for data transfer and analysis**

The Technologist will revise and write scripts, using for example Perl and the Unix c-shell, for automated transfer, organization and analysis of the data. As computers and operating systems are upgraded, there is often the need to revise or develop new capabilities for data transfer, for MRI image as well as raw data. Raw data and images used in customized reconstruction programs and analysis programs, respectively, sometimes require creation of special information files

## **Interact with GE Service personnel, and document their performance**

When MRI systems fail, the Technologist will contact MRI Vendor Service, describe problem and work with Vendor Service to solve problems. He/She will run tests and coordinate scheduling to allow time for servicing the system. He/She will keep a detailed Service Logbook on Vendor service performance issues, such as timeliness and quality of work. He/She will perform daily the Daily Quality Assurance test on the MRI system, as an aid to early detection and diagnosis of system problems.

## **Assistance with electronics of the MRI system and accessories**

The Technologist shall periodically test and evaluate RF coils, physiological monitors, and fMRI stimulus presentation hardware, to insure that it is in good working order. He/She will perform this duty the day before scans using the accessories are scheduled, if the equipment has not been recently (>1 week) used.

## **Maintenance of MRI phantoms and other test equipment**

The Technologist shall be responsible for operating and maintaining MRI phantoms used for testing (e.g. MRI spectroscopy phantom). He/She will be able to interpret the images and test results from these phantoms. He/She shall be responsible for operating and

maintaining test equipment such as oscilloscopes, cable testers, accessory equipment for special pulse sequences and applications (e.g., wave generator and audio amplifier for viscoelasticity measurements, phantoms with moving fluid for flow measurements) and the software interfaces of these devices.

### **MRI Simulator**

The Research Imaging Center operates an MRI simulator (a full size wood replica of the MRI system), which allows patients and subjects to be introduced to the unique experience of having an MRI scan. The Technologist shall become expert in the use of the MRI simulator, including the use of the included computer system and stimulus presentation hardware. He/She shall work with the Vendor(s) of the Simulator and or other equipment if any problems occur.

### **Assistance with grant application preparation and submission**

The Technologist shall help principal investigators in collecting, organizing and submitting information in formal grant applications to NIH, etc., including writing sections specific to the MRI portion of the proposed research, entry of information into electronic forms, and general assistance. He/She shall occasionally deliver documents to campus for administrative review. Principal investigators using the MRI systems will be writing many grant applications.

### **Assistance with poster and oral presentations, and manuscripts**

The Technologist shall assist principal investigators with gathering and formatting material related to the MRI studies, for poster and oral presentations, and for manuscripts. Assistance includes collecting and formatting MRI images, running tests for evaluation of MRI system performance, providing reports of test results (e.g. reporting on the accuracy of the image spatial scale), and performing image analysis measurements, such as SNR and CNR, that reflect system performance.