York
MRI Facility

Standard Operating Procedure #31-01

General Safety Procedures

1. Introduction

1.1. Research involving Magnetic Resonance Imaging (MRI) at high magnetic field strengths present unique hazards to both research subjects and individuals working within and around the MRI system. Consequently, the potential for serious personal injury is present due to the sheer size and strength of the static magnetic field along with the flexibility of the research system and associated peripheral hardware.

1.2. The static magnetic field in the 3T MRI facility is always present. It is important that all those entering the facility be aware of the presence of the field, as it cannot be detected in any way, i.e. magnetic fields cannot be felt, seen or smelled. Ferromagnetic objects brought into the magnet room could quickly become dangerous projectiles, and the magnetic field can also interfere with the operation of certain medical implants.

1.3. During MRI data acquisition the subject being imaged is also exposed to rapidly changing magnetic fields due to pulsed magnetic field gradients, and fields oscillating at radiofrequencies (around 128 MHz for 3 T). These time-varying fields are much weaker than the static field (up to 10 mT or 100 gauss) but create additional safety risks and all personnel working with the MRI equipment must be aware of these risks.

1.4. During certain types of MRI data collection, there exists high, and therefore potentially dangerous, acoustic sound pressure levels (SPL). All those entering the facility must be made aware of this risk and be instructed as to the proper precautionary measures to be taken. Any patients, volunteers and/or research personnel present in the magnet room during an MRI experiment must wear appropriate hearing protection as outlined below.

1.5. As a result of the potential for serious injury, access to the 3T MRI Facility is restricted, and requires permission. See SOP #10-01 “Restricted Access Policy”.

1.6. Any person with intent to enter the Magnet Room must complete a “Magnetic Resonance Safety Screening Form” and have it reviewed and approved by a Level 2 individual before entering the magnet room.

2. Incompatible Medical Devices

2.1. There are medical devices, implants and objects that are incompatible with the MR environment. A copy of Frank Shellock’s “Reference Manual for Magnetic Resonance Safety, Implants, and Devices” is available in the Control Room at the York MRI Facility. Any individual with a device listed as Not Safe or not listed in this reference manual may not proceed beyond the 5 Gauss line unless the object can be safely removed. The 5 Gauss line is marked by the red line at the magnet room door and the edge of the counter facing the magnet room window. There are also areas exceeding 5 Gauss in the Equipment room, thus access must be controlled to this area as well.

3. Safety Issues – Due to High Static Magnetic Field Strengths

3.1. High static magnetic field strengths are present in the 3T MRI Facility. These strong magnetic fields pose potential risks to those working, volunteering, or touring in the environment. Medical safety is very important hence, everyone entering the environment must be aware of the potential dangers.

3.2. All metallic objects have the potential to become projectiles in the MR environment, as they may contain ferrous components. This could potentially cause serious injury to anyone near the magnet, and damage to the MRI system. As a result, objects entering the magnet room are restricted.

3.2.1. The operator is responsible to screen all objects entering the magnet room for ferrous components.

3.2.2. All objects not already I the magnet room, should not be brought into the magnet room unless they are necessary for the successful execution of the experiment, and have been tested using a permanent magnet in the control room, or have been viewed and permitted for entry by the Facility Director.

3.2.3. There are several metals that are non-ferrous. These metals include titanium, copper, gold, silver, aluminum, brass and lead. It is extremely important to note that all metal objects must be tested or permitted for entry by the Facility Director, even if they are thought to have no ferrous components.

3.3. It is mandatory to remove all personal metallic objects from your person before crossing the 5 Gauss line as marked by the door threshold and on signs on the magnet room door. This includes but is not limited to the following list of articles:

Hearing Aids
Dentures
Pager
Cell Phone
Keys
Eyeglasses
Hair Pins
Wigs
Barrettes
Jewellery (including metal body piercings)
Watch
Safety Pins
Paperclips
Magnetic Strip Cards
Coins
Pens
Pocket Knife
Nail Clippers
Foil backed Medication Patches
Steel-toed boots/shoes
Tools

3.4. It is extremely important that no large metal objects be brought into or near the magnet room at any time. All large metal objects must not go beyond the 5 Gauss line as marked on the floor and on signs on the walls, unless specifically directed by the Siemens Service Technician or the Facility Director. A large metal object with ferrous properties, placed to near the magnet, will fly toward the magnet with great force, potentially causing serious injury to anyone near the magnet and damage to the MRI system.

3.4.1. In such an instance, if someone is pinned to the magnet, trapped or potentially in a life-threatening situation as the result of a large ferrous object coming too near the magnet, the operator, or if the operator is pinned, one of the experimental support personnel, must follow SOP #42-01 “Emergency Quench Procedure”, and apply first responder principles.

4. Safety Issues – Due to Rapidly Changing Magnetic Fields

4.1. Rapidly changing magnetic fields are generated by gradient and RF coils in the MRI scanner during data acquisition. These fields pose potential risks for volunteers being scanned and for personnel working in the bore during the scan. To minimize the risk of burns it is important to prevent skin-to-skin contact points and the formation of "closed-loops" from touching body parts. Contact between skin and the transmitting body coil must also be avoided. This can be achieved by using foam padding available on the shelves in the magnet room.

4.2. Objects with good electrical conductance must not be permitted to rest against the skin of the subject within the region spanned by the body coil, and should not be permitted within the body coil unless essential for the successful execution of the study.

4.3. During certain types of MRI data collection, there exists high, and therefore potentially dangerous acoustic sound pressure levels (SPL). It is mandatory for the volunteer/patient, and all others who will be present in the magnet room during the scan session to wear hearing protection either in the form of earplugs or headphones provided by the 3T MRI Facility.

5. Safety Issues – Due to Electrical Power

5.1. There exist dangerous and potentially lethal level of electricity in the 3T MRI system. As such, it is important that all individuals working around the MRI system be aware of the danger and therefore knowledgeable as to the safety issues concerning electricity. There is a risk of electric shock from extremely high voltages, possibly causing severe injury or death, and damage to the MRI system. Only trained personnel should set up hardware in the magnet room and plug in or change the placement of any cables. High currents in wires also pose a risk of fire.

5.1.1. If someone is electrocuted in the 3T MRI Facility, the operator, or if the operator was electrocuted, one of the experimental support personnel, must follow the procedure outlined in SOP #40-01 "Medical Emergency Procedure".

5.1.2. In the case of a fire, the operator must follow the procedure outlined in SOP #41-01 "Emergency Fire Procedure". The operator must keep his/her own safety in mind as a priority while removing the volunteer/patient from the magnet. If at this time the volunteer/patient is not responding, not breathing and has no pulse, the operator must follow the procedure outlined in SOP #40-01 "Medical Emergency Procedure". After all parties are safe, it is appropriate to seek to minimize damage to the system.