



3T MR Research Program

Center for MR Research

TECH 2000 3T MRI RESEARCH FACILITY

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3T MRI Safety

By Mike Flannery

September marked the UIC Vice Chancellor for Administrative Services campus wide initiative to raise awareness, promote a level of resiliency, and ensure a safe learning and working environment to our faculty, staff, students, and visitors. This issue of the 3T MR Research Program newsletter highlights the potential hazards in an MRI environment and ways to safely navigate the MR research experience.

The following topics will be discussed in this issue:

1. MRI Screening
2. Potential dangers of MRI
3. Safety Signage
4. Importance of safety awareness

As many people know, the MRI scanner has a very large and powerful magnet and extreme caution must be practiced at all times when working around the MR environment. To emphasize the magnitude of the magnetic field, the earth's magnetic field is equivalent to 0.5 gauss and our 3T scanner is equivalent to 30,000 gauss. Thus, it is crucial that everyone working around the MRI environment be properly trained in MRI safety.

MR Screening

First and foremost, all users conducting MR research and their participants must be properly screened prior to entering the MRI environment. The 3T MR Research Program provides a safety screening form to help identify any potential dangers or risks for you and your research participants. This form can be found on our website:

<http://chicago.medicine.uic.edu/research/cmrr/cmrr3t/documentationandtools/>

The safety screening form consists of a series of questions intended to inform the technologist of any potential MR safety hazards or direct contraindications for having an MR exam. If a subject indicates "Yes" to any question on the MRI screening form, the issue(s) must be addressed and resolved prior to entering the MR scan room. In particular, metallic implants can pose serious effects such as torque or heating, and may cause artifacts on the image which could interfere with data analysis. Any surgical procedures that the subject has undergone prior to their MR exam must be identified. All surgical implants must be verified for the device's safety at 3T. Many devices that have been tested safe at 1.5T may not necessarily be safe

at 3T. We require the following information to cross reference all surgical devices: manufacturer, model, and where and when the surgical procedure was performed. One good resource to evaluate medical devices safeness within the MRI environment is

www.mrisafety.com

Some surgical implants or medical devices are direct contraindications for having a MRI scan. A subject with a cardiac pacemaker, defibrillator, aneurysm clip, deep brain stimulator, or any other electronic or magnetically activated device will not be scanned or allowed to enter the MR scan room.

Other medical history that may prevent a subject from being scanned would be a prior history of working with metal or a metal injury to the eyes. If your subject has a past history of having metal in the eyes or any injury to the eyes from metal, an x-ray or CT of the orbits will need to be done to screen for the presence of metal.



This orbital x-ray demonstrates a metallic object located at the lower -medial aspect of the right orbit.

Each investigator should follow the guidelines stated within their IRB in dealing with any potential MRI safety issues. The MR Research Technologists will always err on the side of caution with any questionable safety concerns. As a reminder, NO ONE is permitted to enter the magnet room without being cleared by the MR Research Technologist each and every time.

Potential Dangers of MRI

One of the most common and preventable dangers within the MR scan room are projectiles. Any ferromagnetic object may be attracted to the MRI scanner and become an airborne projectile – this is known as the missile effect. This effect is directly proportional to the amount of ferromagnetic material; the greater the amount ferromagnetic material, the greater the force of attraction.

For example, small objects such as a hair pin or paper clip can have a terminal velocity of roughly 60 mph when pulled into a 3T magnet! This obviously could pose a serious threat to the subject and anyone else within the MR scan room if not properly screened. All jewelry, loose metal objects, etc. must be removed from your person and from your pockets prior to entering the magnet room. Due to the strength of the magnet, large objects such as chairs or IV poles can become projectiles and should never be moved into the magnet room.



The magnetic field is not solely confined to the bore of the magnet. The stray magnetic field outside the bore of the magnet is known as the fringe field and it extends in all directions. Thus, caution needs to be taken everywhere within or around the MR scan room.



Image Courtesy of GE Healthcare

Another concern is the acoustic noise while having an MR scan. As current is passed through the gradient coils during image acquisition, a significant amount of acoustic noise is generated. In order to prevent any hearing damage, we always provide subjects with earplugs prior to each exam. The earplugs provide approximately 32 dB of noise attenuation and are suitable for both adults and children.

Burns are another potential risk within an MR scanner. All metal, medical patches (i.e.: nicotine patches, etc), wires from monitor leads, etc must be removed. Certain monitoring devices that use wire leads that may be considered MR safe under strict conditions; however, these devices should never come in direct contact with the subject's skin. There is always a potential risk of different types of items heating up due to their inability to dissipate the heat caused by RF absorption and MR safety guidelines should always be followed.

Although rare, a magnet quench is another danger within the MR environment. During a magnet quench, there is a sudden loss of superconductivity in the magnet coils which results in helium escaping from the cryogen bath extremely rapidly. When a quench

occurs, there is a high possibility of a sudden drop in room oxygen. This is why MR suites are equipped with room oxygen monitors. A quench can be manually initiated, but should only be considered in a life threatening case such as a person being pinned up against the magnet by a large metal object.

Safety Signage

One common misconception is that the magnet is only on when a scan is being conducted. Even when the scanner is not in use, the magnetic field is always present and MR safety guidelines should always be followed.



Always look for posted areas within an MR environment warning of potential safety hazards. If you ever have any questions as to the safety of a certain area and who or what may enter the MR magnet room, always ask the MR Research Technologist. The MRI suite is divided into four distinct safety zones.

Zone I: This region includes all areas that are freely accessible to the general public. This area is typically outside the MR environment itself and is the area through which patients, healthcare personnel, and other employees of the MR site access the MR environment

Zone II: This area is the interface between the publicly accessible, uncontrolled Zone I and the strictly controlled Zones III and IV. Typically, patients are greeted in

Zone II and are not free to move throughout Zone II at will, but are rather under the supervision of MR personnel. It is in Zone II that the answers to MR screening questions, subject histories, etc. are typically obtained.

Zone III: This area is the region in which free access by unscreened non-MR personnel or ferromagnetic objects or equipment can result in serious injury or death as a result of interactions between the individuals or equipment and the MR scanner environment. All access to Zone III is to be strictly restricted, with access to regions within it controlled by, and entirely under the supervision of, MR personnel.

Zone IV: This area is synonymous with the MR scanner room itself, that is, the actual room within which the MR scanner is located. Access to this region is restricted to screened subjects under the direct supervision of trained MRI personnel only.

Importance of safety awareness

It is important to keep the MR control and scan areas secure at all times. This can be accomplished by making sure to keep the MR control/scan room doors shut to prevent unauthorized access. Do not allow anyone in the MR room without being properly screened and cleared by a MR Research Technologist. Also, it is very important to always monitor the subjects while they are in the MR scan room during their exam.

In conclusion, practicing proper MR safety should be a top priority when working in and around any MR environment. Good MR safety practices are vital to protect your subjects, coworkers, and yourself.

Quick Safety tips

- Confirm with CMRR any questionable medical history prior to enrolling subject.
- Try to ascertain whether your potential subject is claustrophobic prior to enrollment.
- Carefully screen the subject and anyone that may accompany them. Provide the MR Technologist with the screening form prior to entering the scan room.
- Bras and belts should also be removed even if they are non-ferrous and are not near the anatomy being imaged. These items may still heat up and reduce image quality by locally altering the magnetic field.