

# Feature File 1 – MRI Projectile Accidents

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Magnetic Resonance Imaging scanners are powerful diagnostic tools used for a variety of conditions. When MRI first emerged as a clinical tool in the 1980's it was regarded as the "safe" imaging technology. High magnetic fields generated by MRI equipment however create constant dangers that require diligent attention and refined safety procedures.

## Known Safety Incidents – what can happen?

J.P. De Wilde, D. Grainger et al in their paper "Magnetic resonance imaging safety issues including an analysis of recorded incidents within the UK", 2007 conclude that "after the exposure of a large number of patients and staff in over two decades of imaging, the main safety incidents were "accidents", this is where a safe working practice has not been followed correctly, for example the bringing into the scan room of ferromagnetic objects.

Most MR incidents can be attributed to the presence of ferromagnetic devices and equipment in the MR environment. Any such device will be subject to the attraction and rotational forces from the static magnetic field. In 2004, Colletti reported an incident where the wrong type of oxygen cylinder was brought into the scanner room while a critically ill patient was being monitored. As the radiographers were removing the patient from the scanner the patient's oxygen levels dropped and an 80Kg oxygen cylinder was wheeled in by the patient's physician. In this instance only the magnet itself was damaged, however a similar incident in 2001 resulted in the death of a young boy when he was struck on the head.

The National Patient Safety Agency in January 2007 reported in their Patient Safety Bulletin, that projectiles from patient safety incidents included objects as diverse as "a mirror, tweezers, keys, a sprung pillow, monitor and syringe driver".

The most comprehensive peer-reviewed paper that quantifies projectile accident risks (Chaljub, Kramer, et al) identified the rate of major projectile accidents as increasing, this "**despite adherence to screening policies before MR imaging and safety education of hospital personnel**". 52% of hospitals in the study reported accidents or incidents. It is also widely accepted that most incidents go unreported. It is estimated reporting in the US accounts for only 1% - 10% of all accidents occurring in the MRI suite.

Of the range of incidents reported by the MHRA in 2006, 27 events, (the second largest single group) were projectile incidents and significantly over 22% of these involved items labelled as MR Safe.



Hospital Bed pulled into 3T Magnet

## Known Costs – Real Figures

Costs associated with an MRI accident can vary irrespective of any potential consequence resulting from injury or harm to patient or staff. Typical costs of an MRI accident could be all or a combination of the following typical elements:

Displacement of gradient coil	£5 - 15K
Replacement cost of scanning table	£3 - 8K
Helium refill cost following quench	£5 - 10K
Emergency service provision @ £3k/day	£9 - 15K
Liability costs	£50K+

## The Regulatory Framework and Global trends for Ferromagnetic Detection.

The death of the 6 year old boy in North America when an oxygen cylinder was inadvertently taken into the MRI room was a touchstone for MRI safety. Subsequent investigations led to the reports of increasing risk factors by safety bodies such as the FDA, ACR and the Joint Commission.

“The proliferation of MRI equipment and significant increases in both magnet strength and spatial gradients... has increased the number of accidents occurring in the MRI suite. Each accident and close call puts patients and staff at risk and carries the potential of damaging, if not crippling, over a million dollars worth of imaging equipment.”

**A member of ACR's  
MR Safety Committee**

(Patient Safety & Quality Healthcare, September/October 2006)

“...there is a strong ‘it couldn't happen here’ mentality. ...I don't believe people are quite aware of the potential problems that can occur, the substantial severity that could occur.”

**Emanuel Kanal, MD, FACR, FISMRM, AANG**  
(Good Morning America, ABC News 08/22/05)

“We believe it likely that accidents and incidents in MR imaging are underreported.”

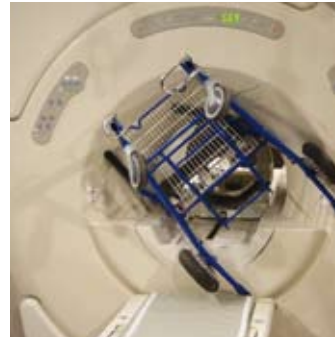
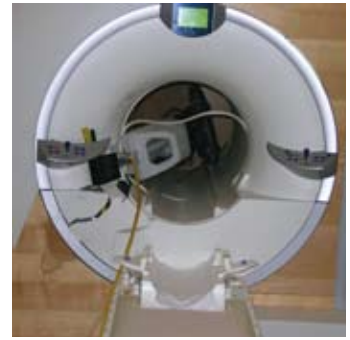
**Chaljub et al**

(From the Study of the University of Texas Hospitals)

### Regulatory Actions

In the UK guidelines for magnetic resonance equipment in clinical use were produced by the Medicines and Healthcare products Regulatory Agency (MHRA) in 2002. In December 2007 these guidelines were updated to acknowledge the availability and use of ferromagnetic detection systems, detailing a number of advantages of their use as an ancillary screening device over standard metal detectors.

The MHRA safety guidance also refers to the American College of Radiology (ACR) White Paper as a useful reference document, itself updated in 2007.



MRI 'projectile' incidents

In July, 2007 the FDA stated: “MR associated accidents, many of them life threatening or fatal are still occurring, causing continued concern in the radiology community.” The “ACR Guidance Document for Safe MR Practices: 2007” referred to by the FDA itself states...

*“Ferromagnetic detection systems have been demonstrated to be highly effective as a quality assurance tool, verifying the successful screening and identifying ferromagnetic objects which were not discovered by conventional screening methods”*

It is relevant to note that the new standards set up in the ACR document were unanimously approved by all committee members, which includes professionals from a broad spectrum of specialties, such as: MR physicists, research/academic radiologists, private practice radiologists, MR safety experts, patient safety experts/researchers, MR technologists, MR nursing, National Electrical Manufacturers Association, the U.S. Food and Drug Administration (FDA), the American Society of Anesthesiologists, legal counsel, and others.

Metrasens' Ferroguard safety system was invented after hearing about the accident that killed the 6 year old boy in the US. Ferromagnetic detection systems are now widely accepted in North America and are increasingly being recognized in Europe as a cost effective way to reduce the risks of projectile incidents

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