

## **MRI of Trauma Patients Treated with Contemporary External Fixation Devices Is without Significant Adverse Events: A Multicenter Study**

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**Background/Purpose:** External fixation is frequently used in multitrauma patients for provisional stabilization of fractures and dislocations. Magnetic resonance imaging (MRI) is often required in these patients to diagnose associated spinal injuries and characterize ligamentous injury in knee dislocations. One disadvantage of MRI, however, is the possible magnetic interaction with components of external fixators. Refusal to perform MRI in patients with external fixators by radiologists or radiology technicians is variable, and creates a clinical problem. Ex vivo studies assessing force and heating response of external fixators inside active MRI machines have been published in both the biomechanical and orthopaedic literature. No studies have evaluated clinical outcomes in patients with external fixators who have had MRI scans. The purpose of this study is to report the safety of placing current MRI components inside and outside the MRI bore during MRI scans.

**Methods:** IRB approval was obtained at each of four trauma centers involved in the study (three Level I, one Level II). A retrospective review of surgical databases identified patients with external fixator applications over a 10-year period from January 2005 to January 2015. Patients were identified with billing records for CPT codes for external fixation and cross-referenced with MRI records at the institution of treatment. Hospital records and imaging studies were reviewed to identify injuries, type and site of external fixation, strength of the MRI magnet, body part imaged with MRI, and any adverse events that occurred. Adverse events were defined as catastrophic pullout of the external fixation device or significant damage to the MRI machine from attraction of the external fixation.

**Results:** After retrospective review of all four centers, 1444 patients were identified from the CPT billing database for external fixators in the 10-year time period of January 2005 to January 2015. 38 patients with 44 external fixators were identified who obtained an MRI with the fixator inside or outside the MRI bore. 12 patients with 13 external fixators had an MRI with the external fixator inside the MRI bore (Table 1). 27 patients with 32 external fixators had an MRI with the external fixator outside the MRI bore. There were no cases of catastrophic failure of the external fixators or damage to the MRI machine with the external fixators inside or outside the bore. The most common reason for obtaining an MRI with a fixator inside the bore was to evaluate knee ligamentous structures following a knee dislocation, while the most common reason for obtaining an MRI with a fixator outside the bore was to evaluate cervical spine injuries in polytrauma patients.

	Injury	Open/Closed	Type of MRI (Company)	Joint	Body Part MRI	Complications
1	Knee Dislocation	Closed	Synthes Large Ex Fix	Knee	Knee	None
2	Knee Dislocation	Closed	Synthes Large Ex Fix	Knee	Knee	None
3	Knee Dislocation	Closed	Synthes Large Ex Fix	Knee	Knee	None
4	Knee Dislocation	Closed	Stryker Hoffmann II Ex Fix	Knee	Knee	None
5	Knee Dislocation	Closed	Stryker Hoffmann II Ex Fix	Knee	Knee	None
6	Left Knee Dislocation Right Knee Ligamentous Injury	Closed	Stryker Hoffmann II Ex Fix	Knee (Left)	Left Knee	None
7	Left Knee Dislocation Right Knee Ligamentous Injury	Closed	Stryker Hoffmann II Ex Fix	Knee (Left)	Right Knee	None
8	Tibial Plateau Fracture	Closed	Stryker Hoffmann 3 Ex Fix	Knee	Knee	None
9	Pelvic Ring Injury	Closed	Stryker Hoffmann 3 Ex Fix	Pelvis	Knee	None
10	Pathologic Acetabular Fracture	Closed	Synthes Large Ex Fix	Hip	Pelvis	None
11	Ankle Soft Tissue Injury	Closed	Synthes Large Ex Fix	Ankle	Ankle	None
12	Calcaneus Fracture Midfoot Dislocation	Open	Synthes Large Ex Fix	Foot	Foot	None
13	Wrist Dislocation Perilunate Fracture/Dislocation	Open	Synthes Small Ex Fix	Wrist	Brachial Plexus	None

**Conclusion:** While no universal guidelines exist, there are circumstances in which obtaining MRI scans of patients with external fixators can be safe and effective. This study fills a large void in the current literature. This is the first clinical series with the primary outcome of safety when placing modern external components both inside and outside the MRI bore during a scan.

The FDA has stated that it is the responsibility of the physician to determine the FDA clearance status of each drug or medical device he or she wishes to use in clinical practice.