

Magnetic resonance imaging for verifying hip fracture diagnosis why, when and how?



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ABSTRACT

Introduction: Hip fractures are commonly diagnosed by plain radiography. When a patient presents with negative radiographs and high clinical suspicion of fracture, guidelines recommend proceeding with magnetic resonance imaging (MRI) to diagnose the patient. The aim of this study was to assess the use of MRI in diagnosing hip fractures following trauma to the hip and describe clinical outcome after MRI-diagnosed hip fractures. The perspective was to develop new recommendations for MRI use.

Materials and methods: 616 patients at a university hospital fulfilled the inclusion criteria of having an MRI scan of the hip following trauma between the years of 2005 and 2014. Data was collected from the patients' medical records.

Results: The annual number of MRIs increased over the ten-year period. Out of 616 MRI scans 228 (37%) showed fracture of the hip with a dominance of trochanteric fractures, 185 (30%) revealed pelvic fracture and 183 (29%) were negative. No patient with acute pelvic fracture had associated fracture of the hip. The main reason to proceed with MRI was a strong clinical suspicion of fracture in patients with negative initial radiographs. Amongst the 228 patients with fracture, 187 (82%) were treated operatively. Of patients with hip fracture, 90 (39%) patients suffered a general complication and 11 (5%) had hip complications. The complication rate of patients with fracture on MRI was compared to that of a cohort of general hip fracture patients at our hospital. No significant difference in twelve months' survival or general complications could be found, but the MRI group had a significantly lower hip complication rate.

Conclusion: The diagnosis set by MRI, with high share of pelvic fractures or no fracture, reflects the difficulty in differential diagnosing this group of patients. The rate of occult hip fractures was low and patients with pelvic fractures already known from X-ray did not have additional hip fractures. We found an increase in the annual number of MRIs during the 10-year-period. MRI-diagnosed hip fracture patients do not suffer more complications than the regular hip fracture patient.

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Introduction

Hip fractures are commonly diagnosed by plain radiography. Using two projections, anterior-posterior and lateral, a vast majority of hip fractures are visualized and can thus be correctly treated. Still, 2–4% of hip fractures cannot be seen on plain radiographs and therefore require additional investigation to reach diagnosis. These are referred to as occult hip fractures [1–5].

Magnetic resonance imaging (MRI) is the preferred modality to diagnose occult hip fractures. Multiple studies have found MRI to be superior, both to computed tomography (CT) and bone scans, in

detecting occult hip fractures [5–7]. Verbeeten et al. showed a sensitivity of 100% in detection of fractures when a senior radiologist evaluated the MRI images [6]. In the absence of fracture, MRI often provides additional information about soft tissue injuries that can be of value to explain the patient's symptoms [8]. A recently published study on the sensitivity and specificity of CT and MRI in diagnosing occult hip fractures found CT and MRI to be equal in detecting femoral neck fractures, where both modalities had a sensitivity of 100%. In detection of fractures of greater trochanter or trochanteric fractures MRI was found to have greater sensitivity than CT. MRI was also deemed to be the better option when deciding whether a fracture is complete or incomplete. The same study also reported CT to have a positive predictive value of 1.00, suggesting that there is no need for additional MRI once CT confirms a fracture [7].

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Current guidelines recommend MRI to be performed within 24 h of admission if hip fracture is suspected and radiographs are negative. If MRI is not available within 24 h, a CT should be performed. In some hospitals, this could result in an increase of CT-scans performed to diagnose hip fractures. If complementary MRI is necessary for diagnosis, there will be further delay to surgery. Preferably, the decision to proceed with further imaging should be made prior to transfer from the emergency department to minimize delay to surgery [9–11].

The study was performed at a university hospital, treating approximately 700 hip fracture patients annually. During the last decade, clinicians have had an apprehension that the usage of acute MRIs is increasing, consuming resources of the MRI department and delaying diagnosis. The aim of this study was to assess the use of MRI in diagnosing hip fractures following trauma to the hip and describe clinical outcome after MRI-diagnosed hip fractures. The perspective was to develop new recommendations for MRI use; and to use the outcome of this study to construct a prospective study to compare operative and non-operative treatment of trochanteric hip fractures only seen on MRI.

This study was approved by the regional ethical committee in Lund, Sweden (EPN 2015/91).

Methods

A list of all patients that underwent an acute MRI of the pelvis and hip between 01 and 01-2005 and 31-12-2014 was retrieved from the Radiology Department at Skåne University Hospital in Malmö, Sweden, a total number of 1313 patients. The referrals of all 1313 patients were screened and referrals containing a question of “fracture” or similar were included, 740 patients in total.

The patients received written information by mail and were given the option to be excluded from the study. 40 patients chose not to participate, or could not be reached by mail and were therefore excluded. Medical records and radiology referrals of the remaining 700 patients were meticulously read and information retrieved was used to create a database. Final inclusion criteria were suspicion of hip fracture, trauma in association with debut of

symptoms and negative initial radiographs. Exclusion criteria were; suspicion of pelvic fracture rather than hip fracture, no trauma, MRI not completed or incomplete documentation. Data was collected and analysed from 616 patients (Fig. 1).

The study consisted of three parts. Regarding acute phase: reading of radiographs, time between trauma and arrival at hospital, X-ray, MRI and surgery, where, when and why MRI referral was written, clinical decision guided by MRI findings and length of hospital stay. Second part included 6 months follow up concerning adverse events such as pneumonia, cardiovascular events and repeated trauma. Finally 12 months follow up on hip complications. We retrieved data of all surgically treated hip fracture patients during the study period from the hospital database.

Data from a previous study on Malmö hip fracture patients by Hansson et al. was used in comparison of mortality- and complication rates [12].

Microsoft Excel 2011 and SPSS statistics version 22.0.0.0 was used to analyse and present data. The trend in MRI use was analysed by linear regression. When comparing complication- and twelve months mortality rates Pearson's Chi square test was used. Significance level was set at $p < 0.05$.

Results

During 2005–2014, 6947 hip fracture patients underwent surgery at our hospital (Fig. 2). Out of these 190 had MRI scans of the hip as part of the investigation. This results in an occult fracture rate of 2.7%. 71 out of the 190 had initial radiographs with some kind of finding that made the radiologist or orthopaedic surgeon suspicious of a fracture. All radiographs are reviewed a second time, usually within 24 h, in this process another 7 fractures were diagnosed. This makes a true occult hip fracture rate of 1.6%.

The number of MRIs performed each year range from 48 to 83, mean value 65.6 (Fig. 3). When analysing MRI usage we included the 40 investigations in patients previously excluded from further medical record analysis. A significant increase (Unstandardized B coefficient 2.570) in MRI usage was found ($p = 0.038$).

Most decisions to proceed with MRI were made on clinical suspicion only, meaning initial X-rays were read as normal (350 out of 616). In 7% of cases did the radiologist suggest additional MRI and it was interpreted in medical notes as the main reason for proceeding with MRI (Fig. 4).

Out of 616 MRI scans 228 showed fracture of the hip with a dominance of trochanteric fractures, 185 revealed pelvic fractures and 183 were negative. Fracture of the major trochanter occurred in 20 cases (Table 1). 20 of the patients with pelvic fractures had primary radiographs showing either clear fracture of pubic ramus, or suspected fracture of pubic ramus or acetabulum. None of these patients had fractures of the hip. No patient with primary

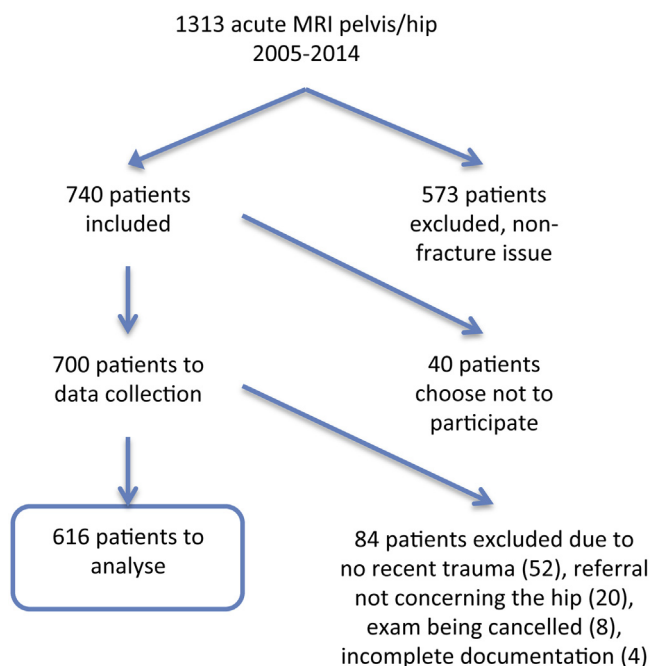


Fig. 1. Flow chart. Inclusion and exclusion of patients.

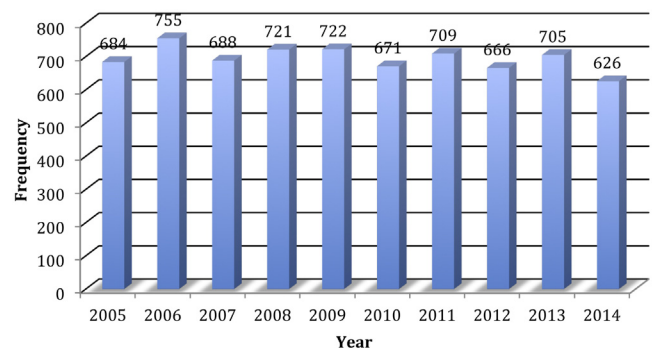


Fig. 2. Number of surgically treated hip fracture patients.

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