The role of MRI in the diagnosis of occult hip fractures

R. Pandey¹, E. McNally², A. Ali¹ and C. Bulstrode¹
¹Departments of Trauma and ²Radiology, John Radcliffe Hospital, Oxford, UK

Undisplaced fractures of the hip can occasionally be difficult to diagnose on radiographs. We performed MRI scans on 33 patients who had post-traumatic painful hips but negative radiographs. Forty per cent of the patients had sustained a fractured neck of femur, 15 per cent had sustained an intertrochanteric fracture and 11 per cent had sustained other fractures around the hip. In one patient a tumour was demonstrated. No fracture was seen in 30 per cent of the patients scanned. MRI is well tolerated by elderly patients in pain, does not involve ionising radiation and provides early and accurate diagnosis in patients with X-ray negative post-traumatic hip pain. © 1998 Elsevier Science Ltd. All rights reserved

Introduction

Early diagnosis of undisplaced hip fractures is important as subsequent displacement of an unrecognized fracture of the neck of the femur significantly alters the management, prognosis, morbidity, length of hospital stay and costs of health care.1

Materials and methods

Between January 1995 and September 1996, 770 patients with post traumatic hip pain were seen in the accident and emergency department. Thirty-three patients (mean age 72) with clinically suspected hip fractures but negative radiographs underwent hip MRI within 48 h of admission.

All patients were scanned on a GE 1.5T Sigma MRI scanner. Three image sequences were employed. Coronal fast STIR (TR:3800, TE:51, TI:120), coronal T1-weighted spin echo (TR:500, TE:17) and axial T2 fast spin echo (TR:6040, TE:102). Two excitations of each sequence were obtained on a 512 x 256 matrix. A field of view was chosen to include both hips. Fractures were diagnosed when there was an area of intermediate signal intensity on the T1-weighted images, representing trabecular oedema, traversed by a low signal line representing the fracture (Figure 1). A corresponding high signal area is seen representing trabecular oedema on STIR images.

Results

In ten (30 per cent) of the patients no fracture was visible on MRI and none of these subsequently went on to fracture (100 per cent true negative). Twenty-two (67 per cent) of the patients had a fracture and in one a tumour was detected. Nineteen (60 per cent) of the fractures involved the neck of the femur in the intertrochanteric area (Table 1). One patient had a fracture of the pubic ramus, one had a fracture of the greater trochanter and one patient had a fracture of the acetabulum.

Thirteen patients (39 per cent) who had undisplaced fracture of the neck of femur were treated with AO screw fixation. Post-operatively all were mobilized with full weight bearing and were independent (on average) by the fifth post-operative day. One patient with a Garden I fracture was managed non-operatively due to co-existing medical problems. The five patients (15 per cent) with intertrochanteric fractures were treated with an AO dynamic screw. These patients were fully weight bearing and independent (on average) by the sixth post-operative day.

Three patients with undisplaced fractures of the greater trochanter, pubic rami and acetabulum were managed non-operatively with physiotherapy. Biopsy in the one patient with tumour demonstrated a myeloma deposit. Twelve patients had associated muscle injuries, six in patients with fractures and six in the patients without fractures. Joint effusions were present in six patients. Femoral head vascularity was normal in all cases.

Ten patients had a normal MRI scan. All underwent satisfactory rehabilitation and were discharged fully weight bearing to the care of their general practitioners. In all cases the GP was contacted a minimum of 6 months post injury and no patient had developed complications.

Discussion

Hip fractures following a fall are relatively common in the elderly and their treatment represents a significant portion of health care expenditure. Despite this, the diagnosis is not always clear-cut clinically and an
initial radiograph may be negative. In this study, MRI was required in 4 per cent of patients who attended the accident and emergency department with post-traumatic hip pain, as initial radiographs did not clearly demonstrate a fracture. MRI confirmed undisplaced fractures in 67 per cent which, if not treated appropriately, could have displaced. The importance of restoring function early for the elderly injured patient has been well recognized. The late detection of fractures increases morbidity, worsens prognosis and prolongs rehabilitation with a consequent increase in health care costs.

Scintigraphy can be useful in the diagnosis of occult fractures around the hip. However, both false negatives and false positives occur. It is time consuming, involves ionising radiation and is non-specific with increased uptake of radio-isotope in osteoarthritis, synovitis, infection and tumours. Scintigraphy is also less reliable in patients with circulatory disturbances and in the elderly.

Recently, isotope bone scans have been shown to be less sensitive than MRI in the diagnosis of hip fractures. CT scanning also exposes patients to ionising radiation. It is limited to the axial plane which is not as useful for surgical planning as the coronal images offered by MRI. Both plain and computed tomography are associated with false negatives, particularly if the fracture line runs parallel to the axial CT plane. The detection of fracture by ultrasound involves identifying the cortical break and the presence of an associated hip effusion. The former can be difficult and less than half the patients in this group had effusions on MR criteria which could have led to false negative diagnosis.

MRI is now commonly used in the assessment of hip joint pathology. It has been shown to be sensitive to both stress and occult fractures. It is becoming more widely available, is non-invasive compared with scintigraphy, and does not expose the patient to ionising radiation. There may be a difference in image quality between magnets but even mid-strength magnets (0.5 T) give acceptable pictures. In patients in severe pain, limiting the examination to T1 weighted images only may be sufficient, reducing the time required for the examination.

In this study there were no false negative diagnoses. Seventy per cent of the patients referred for MRI demonstrated some pathology around the hip. In ten patients without a fracture soft tissue injuries could be assessed. These patients could be given a definitive explanation of their pain, thus encouraging early mobilization. All patients without fracture on MRI were fully weight bearing and pain free at the time of discharge and none subsequently developed complications. A similar non-operative approach was possible in the three patients with fractures of greater trochanter, pubic rami and

---

**Table 1. MRI diagnosis in patients presenting with post-traumatic hip pain and indeterminate radiographs**

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fracture of neck of femur</td>
<td>14</td>
</tr>
<tr>
<td>Intertrochanteric fracture</td>
<td>5</td>
</tr>
<tr>
<td>Pubic rami fracture</td>
<td>1</td>
</tr>
<tr>
<td>Acetabular fracture</td>
<td>1</td>
</tr>
<tr>
<td>Greater trochanter fracture</td>
<td>1</td>
</tr>
<tr>
<td>Tumour</td>
<td>1</td>
</tr>
<tr>
<td>No fracture seen</td>
<td>10</td>
</tr>
</tbody>
</table>
acetabulum. Close supervision of the latter, with follow-up radiographs to guard against displacement, was possible once a definitive diagnosis was established. These patients were re-mobilized with caution, and physiotherapy was tailored to the appropriate fracture.

The main benefit of MRI is to direct early operative intervention in patients with undisplaced fractures. It has been demonstrated that early discharge provides more effective recovery in these patients and is cost effective. In this study the average time taken to become independent was 5 days for a fracture of the neck of the femur and 6 days for an intertrochanteric fracture. One patient with Garden I fracture was treated non-operatively, due to concurrent medical problems, but a confirmed diagnosis allowed appropriate physiotherapy to be instituted. MRI also confirmed normal vascularity of the femoral head in each case with important implications for the choice of surgical management.

MRI availability remains a problem, but improved software and decreased scanning times have reduced costs considerably. In our study, no additional investigation was required and the correct treatment was instituted promptly. We recommend that all patients presenting with significant hip pain following injury and equivocal plain radiographs should undergo MRI.

References