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How can MRI change the treatment strategy in apparently isolated greater trochanteric fracture?

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ABSTRACT

Introduction: The purpose of this study was to evaluate the proportion of greater trochanter (GT) fractures with occult extension to the intertrochanteric region on magnetic resonance imaging (MRI) among apparently isolated GT fractures and to investigate the use of MRI for formulating a treatment strategy in patients with isolated GT fractures.
Patients and methods: This retrospective cohort study reviewed 37 patients with isolated GT fractures on plain radiography. Surgical or conservative treatment was decided according to MRI findings. We divided patients into 3 groups according to the extension of the fracture line. In group 1, the fracture line was within the lateral one-third in the coronal plane. In group 2, the fracture line extended from the lateral one-third to the medial one-third. In group 3, the fracture line extended over the medial one-third and/or to the medial cortex of the femur. Conservative treatment was performed in groups 1 and 2, and surgical treatment was performed in group 3. The clinical results, radiography findings, and MRI findings were investigated.
Results: MRI revealed hidden intertrochanteric fractures (groups 2 [n = 10] and 3 [n = 4]) in 38% of apparently isolated GT fractures on radiography. No displacement was found in groups 1 (n = 23) and 2. Of the 4 patients in group 3, 3 were treated surgically and achieved good functional results and 1 refused to undergo surgery and finally developed complete intertrochanteric fracture. This patient presented 5 days later with increased hip pain, and radiography demonstrated displacement of the fracture, prompting surgical intervention.
Conclusions: The evaluation of apparently isolated GT fractures using MRI can be useful to diagnose the extent of the occult fracture and determine the treatment strategy.

Introduction

Isolated greater trochanteric (GT) fractures are one of the rarest types of hip fracture, and they are generally treated with non-surgical methods [1–4]. For the diagnosis of occult hip fractures in patients with hip pain following trauma, CT, bone scan, and MRI are used in addition to plain radiography, and MRI has been reported to be the best modality for diagnosis [5–8]. Moreover, in some patients diagnosed with an isolated GT fracture on plain radiography, MRI was reported to show the fracture line extending as far as the intertrochanteric area [1–3,9]. However, the best treatment option for such cases is still under debate, and there are no established indications for surgical treatment. Some authors reported positive outcomes with surgical treatment in cases where coronal plane MRI images showed invasion of the fracture line to the central part of the intertrochanteric area [1–3], while others reported positive outcomes with conservative treatment, even when the fracture line extended to the intertrochanteric area [3,8,9]. However, if the fracture extents to the intertrochanteric area and early walking is permitted without precisely ascertaining the region, displacement of the fracture can occur, resulting in negative outcomes, such as difficulties for future surgery, a long period of hospitalization, and a delay in postoperative rehabilitation [7,10]. The treatment methods for isolated GT fractures still lack established guidelines. We hypothesized that the optimal

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treatment method for isolated GT fractures could be determined according to MRI findings. The purpose of this study was to investigate the use of MRI for formulating a treatment strategy in patients with isolated GT fractures on plain radiography.

Patients and methods

The medical records of patients who presented with a fracture of the isolated greater trochanter of the femur between March 2004 and January 2016 were retrospectively obtained from an institutionally approved, single-centre orthopaedic database. This database had not been prospectively formed, but our treatment strategy of apparently isolated GT fractures had been prospectively established. The inclusion criteria were isolated greater trochanter fracture diagnosed on plain radiography and evaluation with hip MRI. The exclusion criteria were children, pathologic fractures, intertrochanteric femur fractures on plain radiographs, lesser trochanter fractures on plain radiographs, and <6 months of follow-up. This study was reviewed and approved by our institutional review board.

MRI was performed at a mean of 21 h (range, 3–240 h) after presentation, using a 1.5-T scanner (Intera, Philips, Netherlands) in the coronal, sagittal, and axial planes. The coronal and axial T1-weighted images were used to determine the fracture extent, because the T1-weighted images were better signal-to-noise ratio and anatomic resolution compared to those of T2-weighted images [3].

We decided the treatment strategy of apparently isolated GT fractures on the plan radiograph according to the MRI findings. We divided patients into 3 groups according to the extent of the fracture line. In group 1, the fracture line was within the lateral 1/3 in the coronal plane (Fig. 1). In group 2, the fracture line extended within the lateral 2/3. In group 3, the fracture line extended over the lateral 2/3 and/or to the medial cortex of the femur. In group 3, surgical treatment was performed, followed by weight bearing as tolerated with a postoperative walking aid. Groups 1 and 2 were treated non-operatively, but the rehabilitation schedule differed between the groups. In group 1, 4 weeks following trauma, after confirming the absence of fracture line extension on plain radiography, full weight bearing was permitted. Group 2 were mobilized non-weight bearing for 2 weeks followed by partial weight bearing for a further 4 weeks. Six weeks following trauma, after confirming absence of fracture line extension, full weight bearing was permitted. Follow-up with clinical examination and hip radiography was performed at 2, 4, 6, and 12 weeks postoperatively. Further radiographs were obtained every 3 months to evaluate clinical outcomes. Six months after trauma, we evaluated clinical outcomes using the Harris Hip score (HHS) [11] and Koval walking ability score [10].

The HHS was compared between the groups using the Mann–Whitney *U* test. All statistical analyses were performed using PASW Statistics version 18.0 (IBM Corp., Armonk, NY, USA). A p-value <0.05 was considered statistically significant.

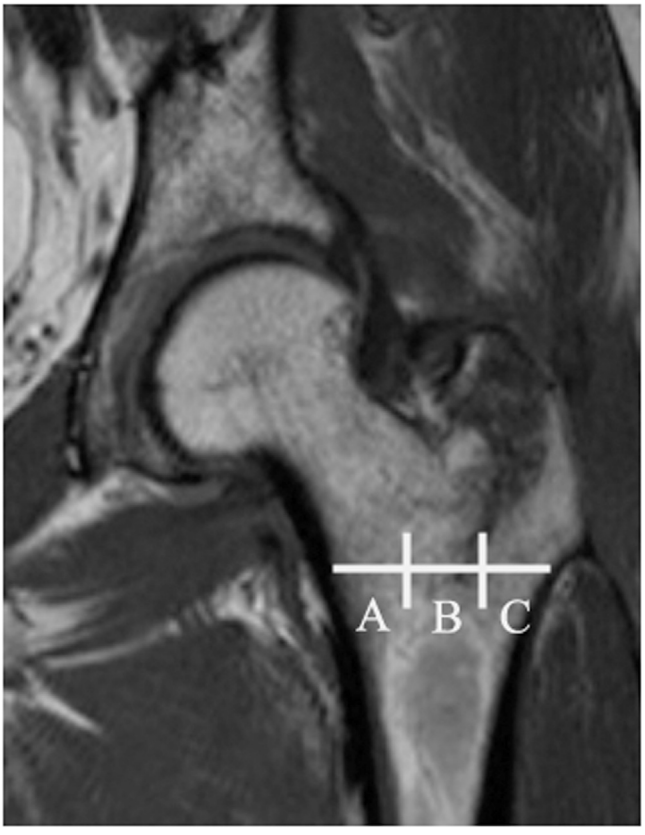

Fig. 1. The model of dividing the patients according to the extent of the fracture line. (A) group 1; (B) group 2; (C) group 3.

Results

In total, 37 consecutive patients (7 male and 30 female patients) were included in this study. The mean age of the patients was 77.1 years (range, 37–89 years), and the mean follow-up period was 12 months (range, 6–26 months).

Of the 37 patients, 36 showed fractures caused by low-energy injuries, such a slipping fall, and 1 showed a fracture caused by a fall from a height. One patient was 37 years old, while 36 patients were older than 65 years. Among the 37 patients, 23 (62%) showed isolated GT fractures on MRI (group 1), while the other 14 (38%) showed incomplete or complete intertrochanteric fractures on MRI (the fracture line extended to the intertrochanteric area [10 patients in group 2 and 4 in group 3]). The clinical treatment and outcomes are summarized in Fig. 2. In group 1, complete intertrochanteric fractures had not developed by the final follow-up, but 4 cases of fibrous union occurred without any clinical symptoms. These patients did not need additional interventions. Similarly, in group 2, complete intertrochanteric fractures did not occur, and all cases showed bone union. In group 3 (surgical treatment), 3 patients underwent surgery (dynamic hip screw or cephalomedullary nailing) and achieved bone union (Fig. 3). However, 1 patient refused surgical treatment and was discharged. This patient revisited the emergency room owing to aggravated hip pain 5 days after trauma, and plain radiography showed a displaced intertrochanteric fracture. The patient finally underwent surgery and achieved bone union.

The mean HHS was 87.4 (range, 78–95). The mean HHSs in groups 1, 2, and 3 were 88.6, 84.5, and 87.6, respectively, and there was no significant difference ($p = 0.842$). Walking ability is summarized in Table 1. No complications, such as nonunion and implant failure occurred, and no reoperation was performed.

Discussion

Isolated GT fractures are one of the rarest types of hip fractures [12]. They are diagnosed through a combination of patient history, clinical examination, and radiological tests. In this study, MRI showed that 38% of isolated GT fractures, which were diagnosed on plain radiography, had an additional fracture line that extended to the shaft or medial cortex. Therefore, the diagnosis of isolated GT fractures with only plain radiographs in such cases would be incorrect. Other studies have mentioned similar findings, together with the importance of MRI. Feldman et al. reported that MRI could more accurately represent an extended fracture line in femoral GT

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