Original article

The role of MRI in the assessment of scaphoid fracture healing: a pilot study

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Abstract. Twenty-two patients with fracture of the scaphoid treated by cast immobilisation underwent clinical examination, radiography and MR scanning 6 weeks after injury. On clinical and plain radiographic criteria alone, 12 patients were considered sufficiently healed to warrant mobilisation. The remaining 10 patients were considered unhealed and were immobilised for a further period. A musculoskeletal radiologist, blinded to the clinical diagnosis, reviewed the MRI scans. Of the 10 patients considered unhealed, 5 had the MR appearances of a united fracture, based on normal marrow signal across the fracture line on T1-weighted images. Of the 12 patients deemed to have united, union could be confirmed by MRI criteria in only 5, but all 12 were healed at 1 year. The results suggest that MRI can provide additional information in this group of patients. It can confirm bony union in a high proportion of patients deemed clinically non-united. Its use in this context will allow a more rapid mobilisation and return to normal function. The significance of persistent MR signal abnormalities in patients who have clinical and radiographic signs of healing merits further study.

Key words: Carpal bones – Fracture – MR imaging – Treatment outcome

Introduction

The assessment of healing of scaphoid fractures is difficult. In the past, clinicians have relied on persistent clinical signs or suspicious plain radiographic features to diagnose delayed union and non-union. Difficulties arise in the interpretation of plain radiographs and tenderness may be persistent even in the presence of a healed fracture. For these reasons, a high proportion of patients undergo prolonged periods of immobilisation which may not be necessary. Magnetic resonance has been well established as a useful means of assessing scaphoid fracture in the immediate post-injury period and in determining the presence of non-union and avascular necrosis. Its value in the assessment of healing has not been assessed in the clinical setting. This study attempts to correlate the clinical and plain radiographic findings with their MR appearances, 6 weeks after a scaphoid fracture. The aim is to determine whether MRI can provide useful information in this group of patients.

Patients and methods

Twenty-two patients with fracture of the scaphoid waist were treated by immobilisation in a short arm cast extending up to the proximal phalanx of the thumb. There were 19 males and 3 females in the study group. The mean age was 34 years. Following informed consent, each underwent clinical examination, X-ray and MR imaging 6 weeks after injury. Clinicians were blinded to the MRI results and patients were managed according to the clinical and X-ray findings alone. Patients with persistent pain, tenderness and X-ray findings suggestive of incomplete healing were managed by a further period of immobilisation. The MRI scans were carried out on a 1-T Siemens Impact MR scanner. Images were obtained in cast, in the coronal plane with T1, T2* and fat-suppressed (STIR) sequences. A dedicated wrist coil was used. Imaging parameters were T1 (TR 400 ms, TE 15 ms), T2* (TR 550 ms, TE 18 ms, flip angle 300°) and short tau inversion recovery (STIR; TR 4300 ms, TE 30 ms, TI 100 ms). A musculoskeletal radiologist who was blinded to the clinical and radiological findings reviewed the images. An MR diagnosis of fracture union was based on the presence of normal T1 marrow signal traversing the fracture line [1]. The presence of a persistent complete fracture line with surrounding trabecular oedema was considered to show that healing had not occurred. All patients were examined clinically and radiographically at least 1 year after injury.
Results

Clinical signs and X-ray evidence of incomplete healing were found in 10 of the 22 patients. In 5 of these patients, MR demonstrated marrow continuity across the fracture line indicating fracture union (Figs. 1, 2, 3; Table 1). Persistent MR signal abnormalities were present in 12 patients (Fig. 4), 7 of whom showed clinical and radiographic signs consistent with healing. At 1 year after injury, 21 patients were free of symptoms and had radiographic signs of union. One patient, deemed non-united both clinically and by MRI, progressed to non-union.

Discussion

The purpose of this study was to provide simultaneous MR information on patients undergoing standard follow up of scaphoid fracture. New imaging techniques are necessary as fractures of the scaphoid continue to present challenges in both diagnosis of acute fractures and assessment of healing. Difficulties in the initial diagnosis of scaphoid fractures are well known. Waizenegger examined 12 clinical signs in injured wrists, with and without scaphoid fracture, at the time of injury and after 2 weeks. None of the signs were reliable in identifying fracture [2]. Information is sparse on the value of clinical signs in determining scaphoid union, but several au-