

Original Research Article

# The Role of Radiology in Diagnosis and Management of Scaphoid Fracture

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## Abstract

**Background:** This study focused on introducing MRI into the diagnostic pathway for suspected scaphoid fracture management. In discussion with our musculoskeletal radiologists, we implemented new guidelines to standardize management of our patients with scaphoid fracture and now report our findings.

**Materials and methods:** A consecutive series of 104 patients referred to the orthopedic department with clinically suspected scaphoid fracture but normal series of plain radiographs were prospectively followed up over a three-year period. We implemented the use of early MRI for these patients and determined its incidence of detected scaphoid injury in addition to other occult injuries. We then prospectively examined results of these findings on patient management.

**Results:** 25 (24%) MRI examinations were normal with no evidence of a bony or soft-tissue injury. Soft-tissue injury was diagnosed in 45 patients (43.3%). Of those, 32 (30.8%) were triangular fibro cartilage complex (TFCC) tears and 13 (12.5%) were intercarpal ligament injuries. Bone marrow oedema with no distinct fracture was discovered in 35 (33.6%) cases. In 12 (11.5%) cases, this involved only the scaphoid. In the remainder, it also involved the other carpal bones or distal radius. Fracture(s) were diagnosed on 27 examinations (25.9%).

**Conclusion:** MRI should be regarded as the gold standard investigation for patients in whom a scaphoid fracture is suspected clinically. It allows the diagnosis of occult bony and soft-tissue injuries that can present clinically as a scaphoid fracture; it also helps exclude patients with no fracture. We believe that there is a need to implement national guidelines for managing occult scaphoid fractures.

## Key words

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Scaphoid fracture, Magnetic resonance imaging, Occult scaphoid fracture.

## Introduction

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The scaphoid is the most frequently fractured carpal bone, accounting for 71% of all carpal bone fractures. Scaphoid fracture often occur in young and middle-aged adults, typically those aged 15-60 years. About 5-12% of scaphoid fractures are associated with other fractures, and approximately 1% of scaphoid fractures are bilateral [1]. The most frequent mechanism of injury for a scaphoid fracture is a fall on the outstretched hand (FOOSH) [2]. The classic hallmark sign of anatomic snuffbox tenderness on examination is a highly sensitive (90%) clinical examination for a scaphoid fracture, however it is non-specific with a specificity of 40% [3, 4]. A clinically important proportion of scaphoid fractures are not demonstrated on a radiograph immediately after injury. Several authors have suggested that fractures of the scaphoid are occult in about 16% of cases on initial radiographs [5-8]. The patient undergoes serial radiographs and clinical review at intervals until a diagnosis is made or symptoms resolve. This can result in unnecessary over treatment of many patients, with further implications for work, daily activities and health care resources. There has been much discussion about the most appropriate investigation of patients with a clinically suspected scaphoid injury but normal plain radiographs. Developments in radiological investigations have increased the options for obtaining such a diagnosis. Recent literature variably suggests that nuclear bone scintigraphy (NBS), computed tomography (CT) and magnetic resonance imaging (MRI) can all be used as the investigation of choice in patients with a clinically suspected scaphoid fracture [9, 10]. The American College of Radiologists (ACR) recognizes the value of MRI and recommends it as the first-choice, second-line investigation [11, 12]. The Royal College of Radiologists (RCR) in the UK has no similar guidelines as evidenced by the inconsistent management of these cases in hospitals around

the country [13]. At our institution, we had no guidelines in place for such patients. Patients were therefore investigated and managed with various methods, including immobilisation with serial plain radiographs and clinical review, NBS, MRI and CT. MRI does not use ionising radiation, so is considered a safer examination. MRI has been proven to be both sensitive and specific for the detection of occult scaphoid fractures, with a suggested sensitivity and specificity of almost 100% [14-17]. This study focused on introducing MRI into the acute diagnostic pathway for suspected scaphoid fracture management in a rural Indian setting.

## Materials and methods

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A consecutive series of patients referred to the orthopedic department with clinically suspected scaphoid fracture but normal scaphoid plain radiographs were prospectively followed up over a 3-year period. All patients were treated with a scaphoid immobilisation splint or plaster and were seen in fracture clinic within one week of the injury. At that review, all patients with clinical signs of a scaphoid fracture were referred for a wrist MRI, which was performed within seven days of request, with a GE Excite Echospeed/ Twinspeed 1.5 T scanner with a GE high-resolution wrist array coil. Routine protocol included sagittal T1 spin echo (SE), axial and coronal T2 fast spin echo with fat saturation (FSE FSAT), coronal proton-density fast-recovery FSE (PD FR-FSE) and coronal 3D fast spoiled-gradient recalled acquisition in steady state (F-SPGR). Our consultant radiologists independently reported on the MRI scans, and patients were then reviewed.

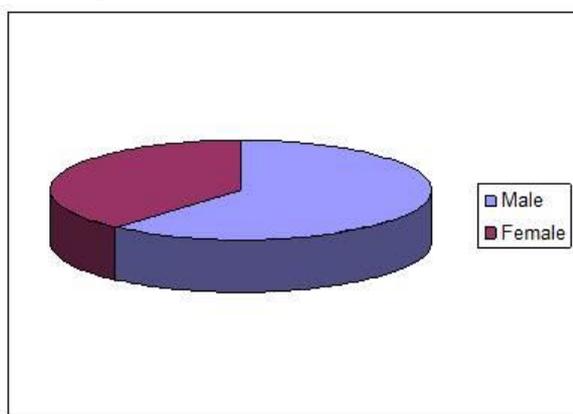
## Results

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104 patients in whom scaphoid fracture was clinically suspected but not demonstrated on initial scaphoid radiographs underwent an MRI within seven days of their first fracture-clinic appointment. There were 64 male (61.5%) and

40 female (38.46%) patients (**Figure – 1**). Injury mode was sporting or accidental falls in all cases. MRI results 25 (24%) MRI examinations were normal with no evidence of a bony or soft-tissue injury. Soft-tissue injury was diagnosed in 45 patients (43.3%). Of these, 32 were triangular fibro cartilage complex (TFCC) tears (30.8%), and 13 were intercarpal ligament injuries (12.5%). Bone marrow oedema with no distinct fracture was discovered in 35 cases (33.6%). In 12 (11.5%) cases, this involved only the scaphoid. In the remainder, it also involved the other carpal bones or distal radius. Fractures were diagnosed on 27 examinations (25.9%). A scaphoid fracture was found in 15 (14.4%) patients, of whom two also had fractures of other carpal bones; 12 (11.53%) patients did not have a scaphoid fracture but were found to have occult fractures of the other carpal bones or the distal radius (**Table – 1**).

**Figure – 1:** Distribution of sex among patients with scaphoid fracture.



**Table – 1:** MRI findings among patients with scaphoid fracture (n=104).

Category	Total cases (%)
Normal	24%
Soft-tissue injury	43.3%
Bone marrow oedema	33.6%
Scaphoid fractures	14.4%
Occult fractures	11.53%

## Discussion

This study demonstrated that in a rural hospital, the early use of MRI in patients with suspected

scaphoid fractures facilitates an earlier diagnosis and management in cases where pathology was diagnosed or the resumption of normal daily routines if normal. This markedly reduced patient inconvenience. There has been much discussion about the most appropriate investigation of patients with a clinically suspected scaphoid injury. Developments in radiological investigations have increased the options for obtaining a diagnosis. Recent literature has variably suggested that NBS, CT and MRI can all be used as the investigation of choice in patients with a clinically suspected scaphoid fracture but normal plain radiographs. Isotope bone scanning is highly sensitive but has a lower specificity, thus leading to a high false positive rate [9, 18, 19]. CT also has similar specificity issues in addition to exposing the patient to ionizing radiation [20-22]. MRI is an effective method for diagnosing occult fractures, having excellent sensitivity, specificity and reliability [20, 23-26]. MRI also allows detection not only of occult fractures of the scaphoid but occult fractures of the other carpal bones [26], bone oedema indicating trabecular injury and soft-tissue injuries to ligamentous structures around the wrist [20]. MRI diagnosis of these injuries allows implementation of early definitive treatment and can thus prevent the need for multiple reviews and immobilisation. Although soft-tissue injuries may not require active treatment, diagnosis can allay patient fears and, again, allow early mobilization and patient discharge. MRI can be used to exclude a fracture and thus prevent overtreatment. MRI excluded fracture in 74 of 104 cases (71.15%), which implies a potential cost and resource benefit by reducing the clinic time required to manage these cases, the period of immobilisation and subsequent patient days off work. Although we did not perform a formal cost analysis, several studies show that the use of early MRI is cost effective in managing occult scaphoid fractures [27, 28]. Dorsay, et al. concluded that MRI costs were equal to those of the traditional protocol due to the reduced number of patients undergoing unnecessary treatment and follow-up [28]. Their study did not, however, quantify the

indirect benefit of earlier return to work. Hansen et al. found that although there was a minor increase in the cost of hospital treatment with MRI scanning, there was a significant reduction in immobilisation time and time off work; they concluded that MRI significantly reduces the cost to society without reducing treatment effectiveness [29]. We feel that the use of a dedicated small extremity scanner with faster scanning protocols would further reduce costs, and we are looking to implement this in our unit. There is a wide variation in the choice of investigation and management of occult scaphoid fractures, as revealed in a number of studies, which indicates that only a small percentage of surgeons are aware of local protocols [13]. In the UK, the RCR produces no specific guidelines to assist in these cases, which could explain the widespread variability, as local preferences and resources dictate management. However, the ACR recognizes the need for an evidence-based approach and produced national guidelines for these cases. They advise that MRI be used as the gold-standard, second-line investigation in preference to CT and NBS [11, 12].

## Conclusion

In conclusion, MRI should be regarded as the gold-standard investigation for patients in whom a scaphoid fracture is suspected clinically. It allows the diagnosis of occult bony and soft-tissues injuries that can present clinically as a scaphoid fracture in addition to excluding patients with no fracture. This ensures that appropriate management can be implemented and thus prevent over- and under treatment. Although guidelines for managing this common problem exist in the USA, there are none in the India. We believe there is a need to implement national guidelines for managing occult scaphoid fractures.

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