

# Acute scaphoid fractures and non-unions

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## Abstract

The diagnosis of scaphoid fractures requires a high index of suspicion, with a focus on the mechanism of injury and careful clinical examination. A scaphoid series of radiographs is required but if negative does not rule out a fracture. If there is clinical suspicion for fracture, one should obtain an MRI scan, which has the highest sensitivity and specificity for diagnosis. The management of acute scaphoid fractures is dependent largely on fracture location and displacement, although there are other factors to consider. On the whole, distal pole fractures can be managed conservatively and proximal pole fractures surgically, as the latter have poorer healing potential with a risk of avascular necrosis, due to a retrograde blood supply. The controversy lies with scaphoid waist fractures. One should consider surgical management for displaced waist fractures. The surgical approach is dependent on the fracture location and the surgeon's individual preference. Scaphoid non-union predictably leads to arthritis of the wrist, and therefore should be managed upon diagnosis. Reconstructive surgery provides the best outcomes, and more research is required into conservative treatments. Recent times have seen an increase in the use of vascularized bone grafts. In cases where there is established arthritis, salvage options include scaphoidectomy with four-corner fusion, proximal row carpectomy, total wrist arthroplasty and arthrodesis.

**Keywords** fracture; non-union; scaphoid

## Introduction

There has been much controversy in the literature regarding many aspects of the diagnosis and management of scaphoid fractures and non-unions. Barton emphasized this with his '20 questions about scaphoid fractures', in his classic paper in 1992.<sup>1</sup> This provides readers with a very insightful and inquisitive approach to this subject. Interestingly, many of the questions he posed remain unanswered today. Barton stated that 'we over-treat a lot of patients to avoid under-treating a few'. This still holds true, indicating our concerns of potential fracture non-union and its effects on wrist function.

The name 'scaphoid' is derived from the Greek word 'skaphe', meaning boat, and refers to its unique shape. It is the most

frequently fractured carpal bone, accounting for approximately 90% of carpal fractures, although it only accounts for 2.4% of wrist fractures.<sup>2</sup> The reported incidence ranges from 1.47 to 121 per 100 000. The peak age of presentation is 20–24 years, with a male:female ratio of 1.55:1.<sup>3</sup>

## Anatomy

The scaphoid is one of eight carpal bones, situated most radially in the proximal row. It functionally bridges the proximal and distal rows. About 80% of the scaphoid is covered in cartilage and its shape incorporates two concavities – one on the volar aspect and one on the ulnar. Appreciating the vascularity of the scaphoid is important in understanding the link between fracture pattern and healing. About 20–30% of the bone, in the region of the distal tuberosity, receives its blood supply from the volar radial artery branches. About 70–80% of the blood supply is from dorsal branches of the radial artery, entering distally at the dorsal ridge. The blood flows retrograde towards the proximal pole, hence the risk of avascular necrosis when it is fractured with lower union rates.

## Management of suspected scaphoid fractures

### History

The importance of a detailed and accurate history from the patient cannot be over-emphasized. The mechanism of injury will direct the clinician along the correct route of investigation. Typically, patients with scaphoid fractures present with a fall onto their hand, with hyperextension of the wrist, together with radial loading of the palm. Weber and Chao<sup>4</sup> showed that when the wrist is hyperextended, the proximal pole of the scaphoid is held as if in a vice between the capitate and dorsal lip of the radius. This position makes it prone to fracture when sufficient force is applied.

Punch injuries, with the wrist in neutral or slight flexion, can also give rise to fractures. 'Kick-back' injuries have also been described, whereby wrist hyperextension is coupled with pronation.

Asides from the mechanism of injury, it is important to elicit when the onset of pain and swelling occurred, as well as the site of pain before progressing onto the examination.

### Examination

All too often wrist injuries presenting with radial sided pain are hastily labelled as 'suspected scaphoid fractures'. A thorough examination, with an appreciation of relevant surface anatomy, will help guide the clinician to a more specific differential diagnosis. On inspection one should look for any swelling in the region of the anatomical snuff box. On palpation, one should look for specific areas of tenderness. No one area can predict a scaphoid fracture well in isolation – instead it is the combination that aids diagnosis. Tenderness in the anatomical snuff box, as well as over the scaphoid tubercle, with pain on axial compression of the thumb, may be indicative of fracture. When palpating for tenderness in the anatomical snuff box the wrist should be ulnar-deviated to present the greatest surface area of the scaphoid beneath this site. Note that the anatomical snuff box may be tender without a fracture being present, due to compression of a sensory branch of the radial nerve.

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Examination of the normal side for comparison is imperative! Another clinical test that may be of use is pronation of the wrist with ulnar deviation, giving rise to pain in the region of the anatomical snuff box.

### Investigations

The next step in investigating a potential scaphoid fracture is to obtain radiographs. The 'scaphoid series' provides multiple views to help visualize a fracture. What is important is to obtain a four- or five-shot series. Typically, this includes the following radiographs:

- posteroanterior (PA)
- PA with wrist extension and ulnar deviation
- 45° pronation PA
- 45° pronation PA with ulnar deviation
- lateral.

It is important to note that the negative predictive value of radiography is low and up to a quarter of fractures are missed without using further imaging modalities.<sup>5</sup> Furthermore, evidence in the literature suggests that repeating the radiographs several weeks after injury does not improve the diagnostic accuracy.<sup>5</sup> Hence if a fracture is suspected with normal radiographs, then alternative imaging is recommended.

Multiple second-line investigations have been analysed in the literature, each with positives and drawbacks. Ultrasound is radiation-free but user-dependent. Isotope bone scanning has good sensitivity for detecting injury, but lacks specificity. CT and MRI scans are commonly used in current practice. The former is useful for evaluating the fracture pattern and can look for bony bridging at the fracture site in cases of delayed presentation. The latter has been shown to have a negative predictive value of

100% and can also detect other injuries, particularly ligamentous.<sup>5</sup> The choice of second-line investigation is often dependent on resources available at local healthcare providers, which influences local guidelines. However, our recommendation is for use of MRI scan, given this has the highest sensitivity and specificity.

### Summary

The management of a suspected scaphoid fracture requires a high index of clinical suspicion and is based upon a detailed history, paying particular attention to the mechanism of injury, onset and site of initial pain, backed by a targeted clinical examination (Figure 1). Detection of multiple positive clinical findings helps point towards a diagnosis. A scaphoid series of radiographs is mandatory. Currently MRI scanning provides the highest sensitivity and specificity for investigation of a radiographically occult scaphoid fracture.

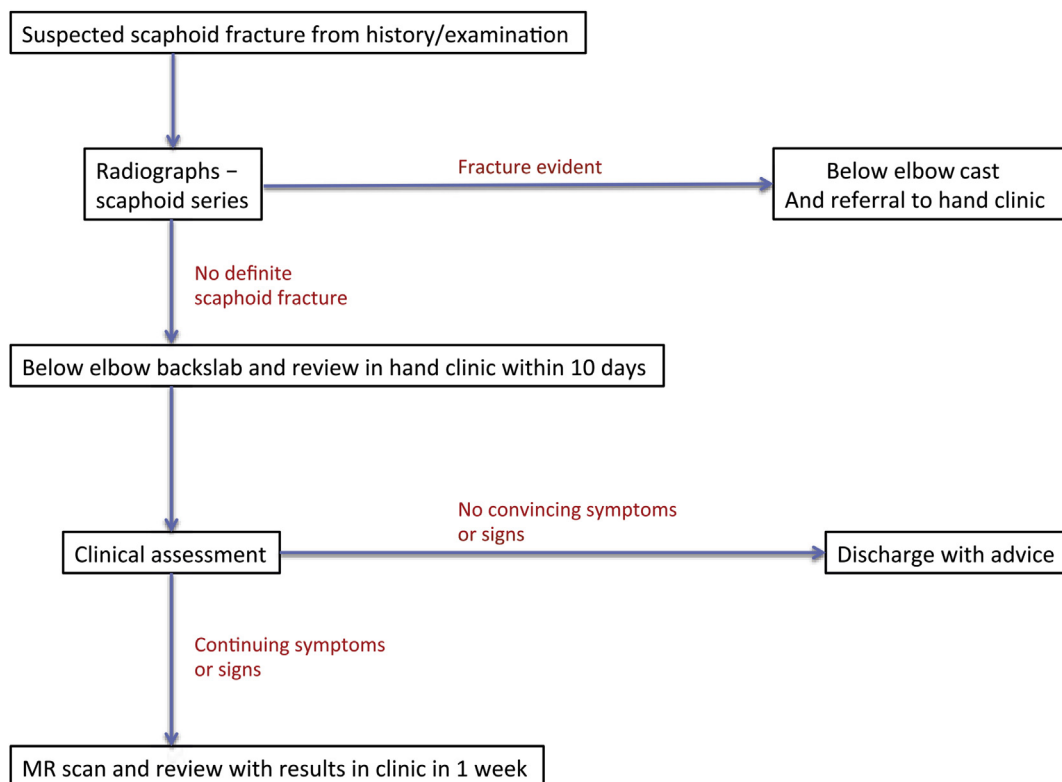
### Management of a confirmed scaphoid fracture

Referring back to Barton's statement: 'we over-treat a lot of patients to avoid under-treating a few', we would recommend the reader considers the following questions when faced with a patient presenting with an acute scaphoid fracture:

- To operate or not?
- What type of operation?
- If non-operative treatment, what?

### To operate or not?

In order to answer the first question, one should consider three further questions:



**Figure 1** Author's recommended algorithm for management of suspected scaphoid fractures.

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