Management of acute scaphoid fractures: a pragmatic approach for the non-specialist

Abstract

Scaphoid fractures are common and can cause significant morbidity if treated incorrectly. Thus, a working knowledge of the initial assessment and management of scaphoid fractures by non-specialists is crucial to allow quick diagnosis and avoid potentially catastrophic complications of scaphoid fracture. This article summarises the anatomy of the scaphoid, discusses methods to assess for scaphoid fractures and delineates management plans (conservative or operative) for fractures of the scaphoid based on location of vascular compromise. This article can also help the clinician predict which fractures may not unite with conservative management and therefore need referral to a specialist orthopaedic surgeon for possible surgery.

Key words: Fracture; Hand injuries; Non-specialist; Scaphoid; Wrist anatomy

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Introduction

Fractures of the scaphoid are common and account for 2% of all fractures (Rhemrev et al, 2011). Hand injuries have a devastating impact on an individual's socioeconomic wellbeing and cost the British economy in excess of £100 million per year (Dias and Garcia-Elias, 2006). The scaphoid is a vital link between the wrist and hand, and an integral part of the wrist joint. The undulating shape of the scaphoid makes fractures difficult to diagnose on a two-dimensional image such as that produced by plain X-rays. The limited blood supply of the scaphoid means that a failure to diagnose and treat these fractures in a timely manner results in a potentially catastrophic sequence of avascular necrosis, arthritis, unremitting pain and stiffness. Missed scaphoid fractures are also the leading cause of medicolegal claims in hand surgery. The average claim against the NHS for a misdiagnosed scaphoid fracture is over £50 000, with the total cost of claims relating to scaphoid fractures over a 17-year period in excess of £3.4 million (Ring et al, 2015). Every clinician should have a working knowledge of how to diagnose a scaphoid fracture and commence first-line treatment. This review presents a pragmatic approach to recognising and treating scaphoid fractures for the non-specialist.

Anatomy

Osseous and vascular anatomy

Referred to as the 'boat-shaped' bone, the scaphoid is the largest of the carpal bones (White et al, 2015). It is located at the radial end of the proximal carpal row with its long axis aligned obliquely. It is positioned between the radial styloid proximally and the trapezium and trapezoid distally. The scaphoid is divided into four distinct regions: tubercle, waist, proximal and distal pole. Bone density is highest at the proximal pole and lowest at the waist as a result of the difference in the thickness of trabeculae (Ahrend et al, 2021). It has three non-articular surfaces. The dorsal surface is on the posterior aspect of the bone and houses the nutrient foramina. The palmar surface is on the anterior aspect of the bone and contains the tubercle of the scaphoid. The lateral surface provides an attachment for the radial collateral ligament (reinforces the articular capsule of the radiocarpal joint and stabilises the radiocarpal relation) (Brown et al, 1998). The remaining surface, comprising 75% of the surface area of the bone, is articular cartilage. This allows the scaphoid to form a joint with the radius, lunate, capitate, trapezium and trapezoid (Figure 1) (Ring et al,

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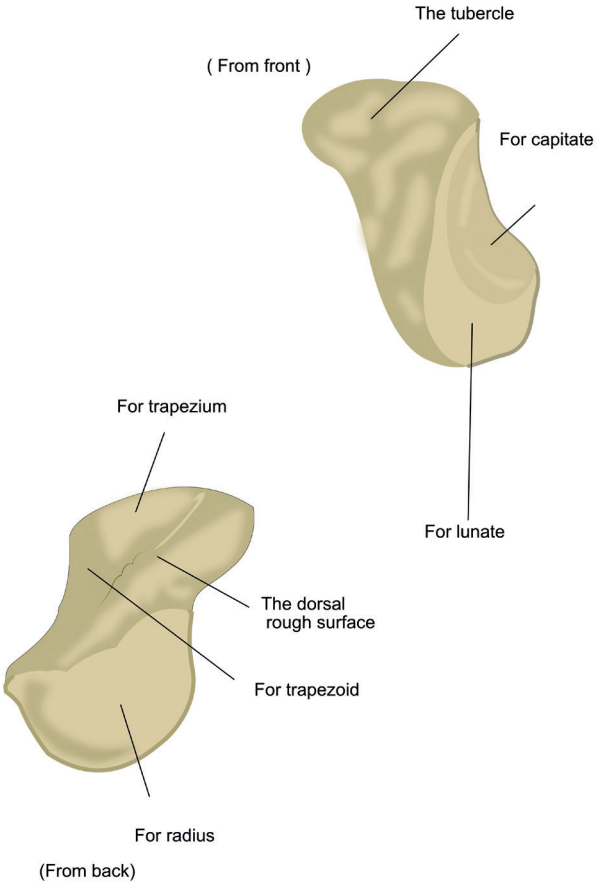

Figure 1. Anatomical relations of the scaphoid.

2015). This is the reason why the scaphoid has such a limited blood supply as vessels cannot penetrate this articular cartilage. This means that following a fracture, there are only a limited number of blood vessels penetrating the bone and supplying critical areas, making the scaphoid susceptible to non-union and avascular necrosis.

The distal part of the scaphoid (20–30% of the bone) is supplied by direct branches of the radial artery or the superficial palmar arch (Gelberman and Menon, 1980). The anterior interosseous artery (arising from the ulnar artery) also supplies collateral circulation to the distal region (Gelberman and Menon, 1980). The proximal aspect of the scaphoid (70–80% of the bone) is supplied by the radial artery, which enters the scaphoid through the dorso-radial ridge (Gelberman and Menon, 1980). The branches of the artery enter through the vascular foramina located at the ridge, divide and run proximally (Sendher and Ladd, 2013). This is referred to as the retrograde vascular supply and supplies all of the proximal pole of the scaphoid (Figure 2). A fracture through the waist or the proximal pole of the scaphoid can disrupt the intraosseous vasculature and result in post-traumatic avascular necrosis of the proximal pole of the scaphoid (Large et al, 2019). The scaphoid is an integral part of the proximal carpal row and has an important role in wrist movement. The scaphoid forms a link with the lunate and triquetrum in the proximal role. Any injury to the scaphoid can disrupt this link and therefore the complex synchronous movement involved in that area. This can lead to premature wear to the wrist joint surface.

Assessment of injury

Epidemiology and biomechanics of injury

Men are more likely to develop scaphoid fractures than women, with the median age at the time of injury also significantly lower in men (Garala et al, 2016). The mechanism of injury is typically a result of the forced extension of the wrist. In this position, the scaphoid is

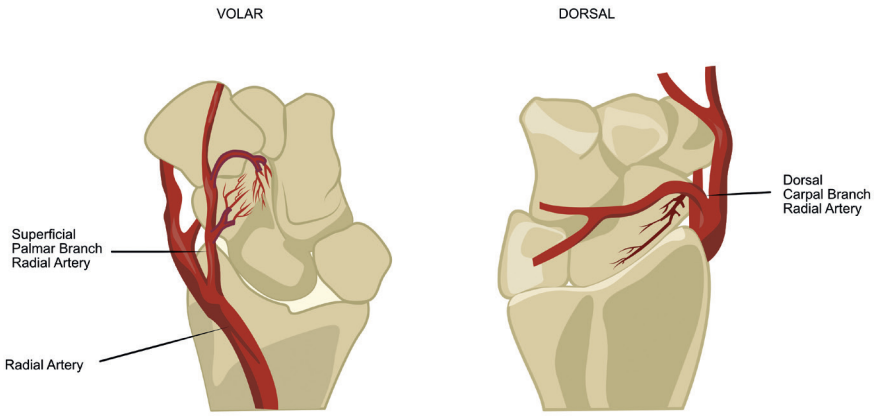

Figure 2. Blood supply to the scaphoid.

squeezed between the radial styloid and the trapezium and trapezoid, placing the scaphoid under significant force. A low-energy injury caused by a fall on an outstretched hand is the commonest presentation of this injury, with high-energy injuries resulting from road traffic accidents also prevalent (Duckworth et al, 2012). Interestingly, there is a seasonal trend, with most fractures diagnosed during June and fewest in December (Garala et al, 2016).

Recognising the injury

A high degree of clinical suspicion is imperative in recognising a scaphoid fracture. Without a suspicion of the fracture, the physician risks misdiagnosing the injury as further imaging may not be performed. A lack of clinical signs specific to scaphoid fractures result in the majority of misdiagnoses (Jamjoom and Davis, 2019). Nevertheless, there are three established signs to be aware of during the assessment of any wrist or thumb injury: anatomical snuffbox tenderness, scaphoid tubercle tenderness and pain on longitudinal compression of the thumb (Figure 3).

The absence of anatomical snuffbox tenderness is considered to be the most sensitive test and diminishes the likelihood of a scaphoid fracture (Carpenter et al, 2014). This is often mistaken for palpation of the base of the metacarpal in the thumb, so it is useful to be aware of where the scaphoid lies in the anatomical snuffbox. Second, the palmar surface of the bone houses the tubercle of the scaphoid. Pain on palpation of the scaphoid tubercle is also considered a sensitive test for picking up fractures of the scaphoid (Parvizi et al, 1998). This is performed with the wrist in neutral or radial deviation and can be felt on the palmar aspect of the wrist and the base of the thenar eminence in the region of the distal wrist crease. A third sign, pain on axial loading of the thumb, achieved by applying

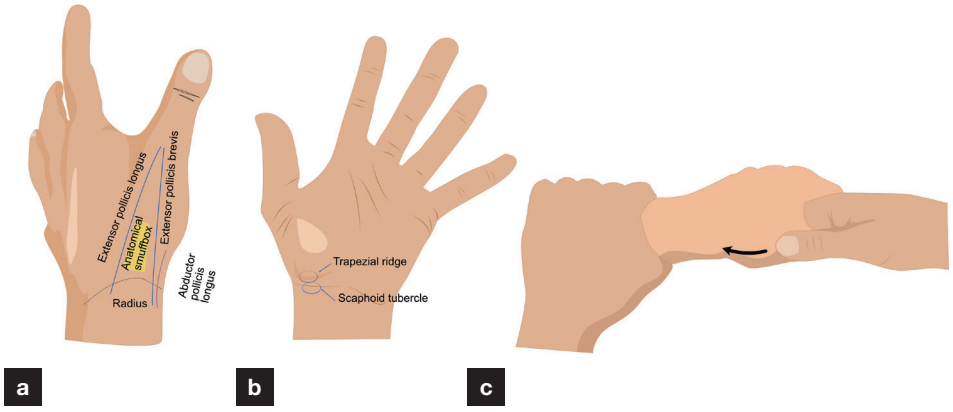

Figure 3. Tests to assess scaphoid fractures. a. The location of the anatomical snuffbox which can be palpated to elicit tenderness. b. The location of the scaphoid tubercle which can be palpated to elicit tenderness. c. Longitudinal compression of the thumb to elicit pain in the wrist.

pressure along the thumb metacarpal, is another sensitive test (Chen, 1989; Parvizi et al, 1998). However, none of these tests is specific as other soft tissue injuries of the wrist or thumb may present similarly (Jamjoom and Davis, 2019). Therefore, these examinations must not be performed in isolation – combining the three of them for each patient is the optimum approach to attain an accurate level of suspicion of diagnosis and forms the backbone for requesting further imaging (Parvizi et al, 1998).

First-line investigation is X-ray imaging. Owing to the complex anatomy and position of the scaphoid, a simple postero-anterior and lateral X-ray alone are often not enough to detect a scaphoid fracture. To increase the likelihood of detecting a fracture, a scaphoid series should be requested. This comprises a standard (neutral rotation) posteroanterior and lateral view, a semi-pronated (45°) oblique view and scaphoid view (posteroanterior with the wrist in ulnar deviation and 30° extension). This series of X-rays increases the chances of capturing an X-ray in the same plane as a fracture, so it can be viewed. Often the initial X-rays can be negative so there is a role for repeat X-rays at 14 days if clinical suspicion remains. At 14 days, the sensitivity of X-rays can be higher, as one of the first stages of fracture healing results in haematoma formation in the fracture site and the bone ends resorbing, resulting in a fracture that can be easier to see. Despite this, the sensitivity of follow-up X-rays remains poor and therefore further imaging is often required (Low and Raby, 2005). Magnetic resonance imaging is the most accurate imaging modality to recognise scaphoid fractures (Duckworth et al, 2011; Jamjoom and Davis, 2019). The National Institute for Health and Care Excellence (2016) guidelines state that magnetic resonance imaging should be considered if there is any suspicion of a scaphoid fracture. Computed tomography is inadequate to exclude scaphoid fractures, but can be used to rule them in (Jamjoom and Davis, 2019).

Management

Management of any fracture falls into two broad categories, a non-operative approach with immobilisation of the joints involved and a surgical approach involving fixation of the fracture parts. Deciding on the management approach is complex for scaphoid fractures because of the variation in the anatomical site of fracture and the distinct types of fractures present (Figure 4). The authors propose a logical method to categorise fractures of the scaphoid to aid decision making for the non-specialist dealing with these injuries. Once a diagnosis is reached, it is essential and time-critical to identify which fractures have a higher chance of non-union with non-operative management, in order to arrange and expedite surgical intervention. Hence, management should be based on two main principles, the biology of the bone (blood supply) and the stability of the fracture (Figure 5).

Classically, fractures of the scaphoid are broadly classified into proximal pole fractures, waist fractures and distal pole fractures. Approaching this in terms of fracture biology (blood supply) and stability, proximal pole fractures are unlikely to unite with conservative management and immobilisation (Eastley et al, 2013; Tada et al, 2015). Therefore, all patients with proximal pole fractures must be considered for surgical management, often in the form

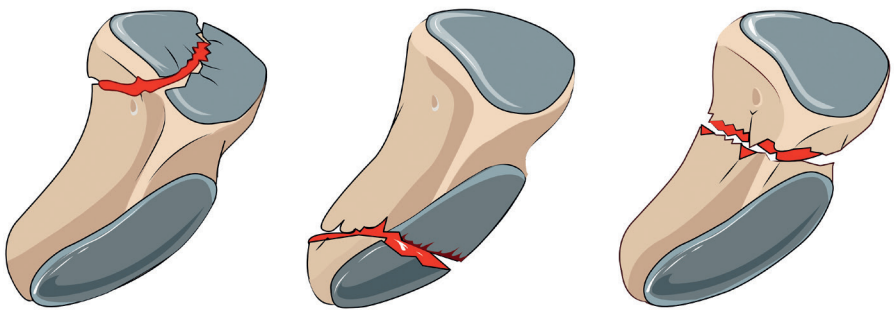

Figure 4. Location of fractures of the scaphoid.

of a percutaneous antegrade screw (Herbert and Filan, 1999; Severo et al, 2018). On the other side, the distal pole of scaphoid possesses an excellent blood supply, making it the perfect candidate for non-operative management, as union is expected (Puopolo and Rettig, 2003). The sole reason to consider surgical intervention for distal pole fractures would be a stability concern at the fracture, in the form of fracture comminution and displacement of fracture parts (Naranje et al, 2010). The waist of the scaphoid can have problems with both fracture biology and stability and management depends on assessing the displacement of fracture parts. In an undisplaced scaphoid waist fracture, issues with fracture biology and stability are unlikely and a non-operative approach is appropriate (Vinnars et al, 2008). Conversely, displaced fractures may have problems with both fracture biology and stability. This displacement (separation) of the fracture fragments can result in the scaphoid collapsing into a humpback deformity. This is a result of the ligamentous pull on the separate fracture fragments as the lunate pulls the proximal fragment into extension and the distal fragment remains flexed as a result of the close contact with the trapezium and trapezoid. Based on these reasons, surgical management is endorsed (Naranje et al, 2010; Singh et al, 2012).

Conclusions

Fractures of the scaphoid are common and need early recognition and appropriate management to avoid complications. Having knowledge of the fracture anatomy and biology can help the clinician predict which fractures may not unite with conservative management and therefore which fractures they would need to refer to a specialist orthopaedic surgeon for possible surgery.

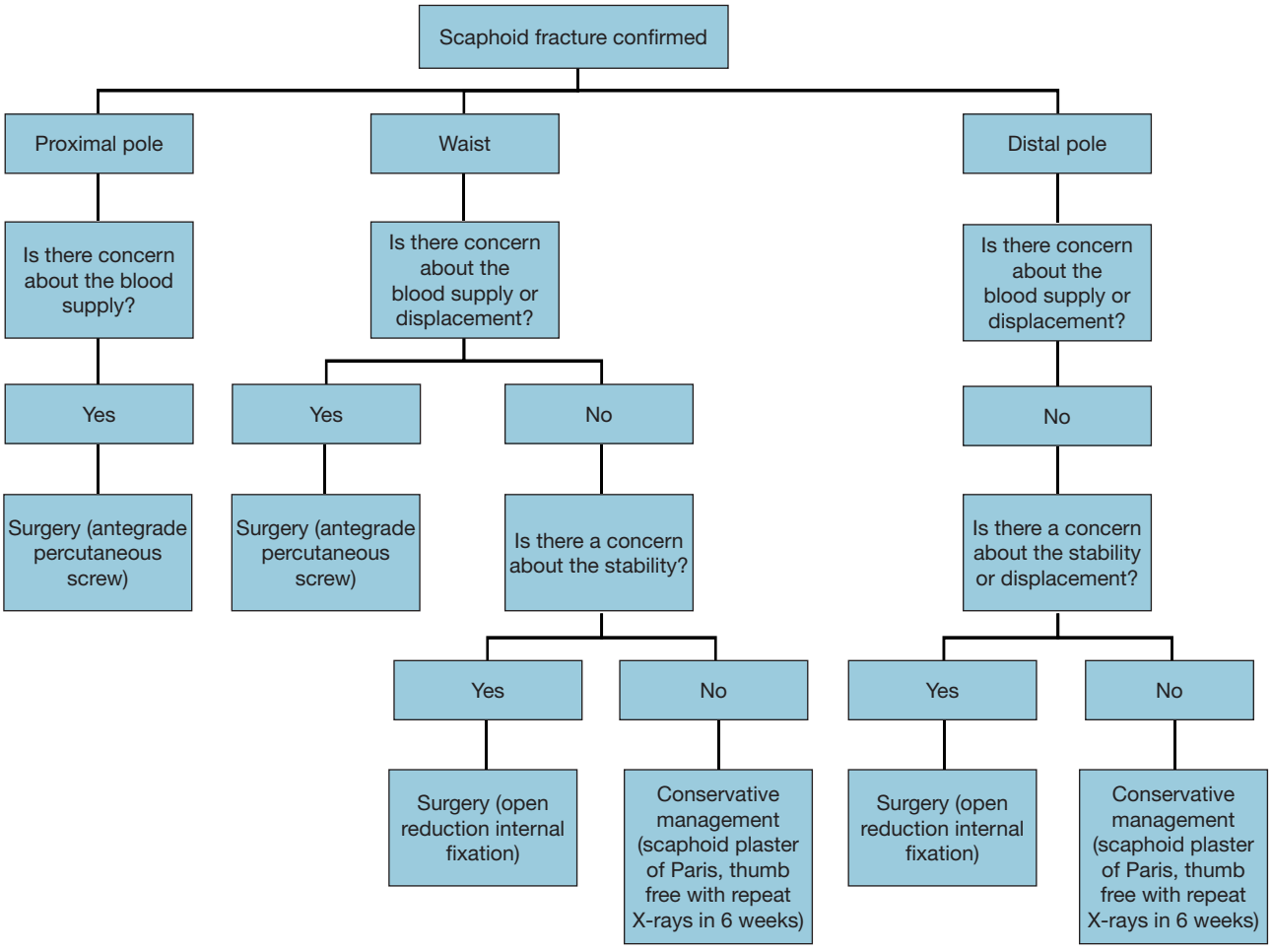

Figure 5. Management strategies based on location of fracture, stability and vascular compromise.

Key points

- Fractures of the scaphoid are a common injury, especially after a fall on an outstretched hand.
- Missed scaphoid fractures are a leading cause of medicolegal claims in hand surgery.
- Proximal scaphoid fractures can result in avascular necrosis which can be functionally detrimental to an individual's life.
- X-ray imaging cannot fully exclude a scaphoid fracture and the role of magnetic resonance imaging is vital.
- Strategies for managing scaphoid fractures are based on location of fracture, stability and vascular compromise.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

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