CASE REPORT

Segmental fracture of the scaphoid

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SUMMARY

We present a rare case of segmental fracture of the scaphoid. This case highlights the importance of using appropriate imaging modalities to assess the presence and morphology of fractures.

BACKGROUND

The scaphoid is a biomechanically important carpal bone, which stabilises the midcarpal joint during wrist movement. Despite being the most frequently fractured carpal bone, scaphoid fracture management varies widely within and across hospitals. There are no national guidelines in the UK.

Scaphoid fractures can lead to significant morbidity. They are associated with complications such as avascular necrosis, non-union, scaphoid non-union advanced collapse and osteoarthritis of the carpus. Timely identification of scaphoid fractures is therefore crucial. Establishing the fracture pattern also has important implications for management and outcomes.

CASE PRESENTATION

A fit and well 20-year-old man was playing korfbal when he ran straight into a wall with both hands outstretched. He was right hand dominant and a non-smoker. There was no history of previous hand injury.

INVESTIGATIONS

Radiographs identified a non-displaced left scaphoid fracture through the waist (figure 1).

TREATMENT

The injury was treated conservatively with wrist immobilisation in a Colles' cast for 8 weeks. The splint was then removed and the patient was encouraged to move the hand to prevent stiffness. On clinical examination 3 months following the injury, the patient still had mild tenderness of the anatomical snuffbox. Repeat radiographs of the left scaphoid showed that the fracture line was still visible, and appeared to be undergoing delayed union. To assess for any other occult fractures, an MRI scan was performed, which showed an unexpected feature of two separate non-displaced fractures running across the scaphoid (figure 2). The most proximal fracture ran across the junction of the proximal and midthirds, while the more distal fracture ran across the junction of the mid and distal thirds. There was evidence of healing of the proximal fracture line. However, the most distal fracture line was still clearly evident although poorly defined.

There were no signs to suggest avascular necrosis. As there was minimal displacement, conservative management was continued with a Futuro splint for a further 3 weeks. The Futuro splint has a rigid volar support and a soft dorsal aspect. This provides moderate-stabilising support for the wrist, while keeping the thumb and fingers free. After 3 weeks, the patient had no further tenderness at the fracture site and the splint was removed.

OUTCOME AND FOLLOW-UP

Seven months following the injury, a CT scan was arranged to confirm bony union, given the unusual fracture pattern. This showed that both fractures had healed. On examination, he had a normal range of wrist and hand movement with no pain.

DISCUSSION

Scaphoid fractures account for 50%–80% of carpal bone fractures in young adults.¹ The mechanism of injury normally occurs through axial loading of a hyperextended and radially deviated wrist.² The scaphoid receives its blood supply primarily from two branches of the radial artery. The distal pole is supplied by both the palmar scaphoid branch of the superficial palmar branch of the radial artery and the dorsal scaphoid branch from dorsal carpal branch of the radial artery. The latter of these also supplies the proximal pole through retrograde intraosseous flow, which can become disrupted following scaphoid fracture and lead to non-union.³

Scaphoid fractures can be overlooked or misdiagnosed as simple wrist sprains. If missed, complications such as malunion, non-union or avascular necrosis can develop with resultant pain, osteoarthritis and reduced range of wrist movement.⁴ Untreated, the risk of non-union is up to 10%, and in displaced fractures this rises to 55%.^{5–7} Scaphoid non-union affects wrist joint function and is associated with a predictable pattern of degenerative arthritic change, known as scaphoid non-union advanced collapse (SNAC). Early diagnosis and commencement of appropriate treatment are crucial to reduce the risk of these complications.^{8,9} Likewise, early exclusion of fracture avoids overtreatment, reducing unnecessary healthcare follow-up and facilitating timely return to work for the patient.¹⁰

Fractures of the scaphoid occur at three main anatomical sites. Most commonly, fractures occur through the waist of the bone (70%), then at the proximal pole (20%) and the remainder occur at the distal pole (10%).¹¹ Due to the tenuous blood

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Figure 1 Anteroposterior (left) and lateral (right) radiographs of the left wrist demonstrating initial fracture pattern.

supply of the proximal fragment, the prognosis for proximal fractures is generally worse than for distal fractures.⁹

Plain radiographs are the standard initial investigation of suspected scaphoid fractures. It is recommended to perform four 'scaphoid views': posteroanterior, lateral, semipronated oblique and posteroanterior with ulnar deviation.¹² Up to 16% of scaphoid fractures may be missed on initial radiographs.¹³ It can take 1 to 2 weeks for fractures to become evident on plain film, and some will remain radiographically occult for up to 6 weeks.¹⁴ In patients where there is high clinical suspicion but negative radiographs at presentation, it is conventional practice

to perform repeat radiographs and clinical examination after 2 weeks of immobilisation.⁸

MRI has been shown to be the most sensitive and specific modality in picking up the presence of a fracture (97.7% and 99.8%, respectively).¹⁵ In the situation where radiographs are negative but clinical suspicion is high, Dorsay *et al* compared costs of early MRI with the traditional 2-week clinical and radiological follow-up.¹⁶ When loss of productivity and income were also considered, the authors favoured early MRI over the traditional protocol. MRI is also considered the gold standard imaging modality for the detection of avascular necrosis.^{17 18}

If a fracture is suspected, MRI is considered inferior to CT for the identification of fracture location, morphology, displacement and union status.⁸ Smith *et al* therefore recommend CT as standard after all initial positive radiographs.⁸ CT also has an 85.2% sensitivity and 99.5% specificity for the detection of acute scaphoid fracture.¹⁵ CT is also widely used for assessing non-union and concurrent osteoarthritis.¹⁹ It is said that the images derived from CT scan permit the surgeon to understand the 'personality of the fracture'.²⁰ In our case, an MRI was requested to assess for other occult fractures and rule out avascular necrosis. In the presence of avascular necrosis, we would have considered vascularised bone grafting. As the fracture was minimally displaced on the radiograph, a CT scan was not performed as information on the fracture morphology would not have affected the management.

Ultrasound in therapeutic range has no role in modern scaphoid fracture imaging; however, high-spatial resolution sonography is able to assess the dorsal scaphoid waist. The modality can be used to detect disruption of the scaphoid cortex, or effusions at the radiocarpal or scapho-trapezium-trapezoid joints. The test is safe, low cost and non-invasive. However, there is a high dependence on sonographic skill and the potential to miss associated fractures of the other carpal bones or the distal radius.^{21 22}

Bone scintigraphy has high sensitivity (94%–100%) but low specificity (60%–95%) due to false positives related to inflammatory states such as synovitis.⁸

The treatment of scaphoid fractures depends on the degree of displacement. The meta-analysis by Alshryda *et al* concluded that conservative management of acute scaphoid fractures should be with a Colles' cast for up to 12 weeks, and that above-elbow casts offer no additional benefits to below-elbow casts.¹ A classification commonly used to help guide treatment is the Herbert classification A to D. In the Herbert classification, A and B are acute fractures and C and D are chronic. Herbert type A fractures are stable while B are unstable. Conservative management with a cast is typically chosen for A-type fractures, and operative fixation is reserved for B-type fractures. Rate of union in undisplaced scaphoid fractures following immobilisation is 88% to 95%.^{23–25}

Type B fractures are considered unstable because there is displacement of bony fragments of more than 1 mm², which is associated with non-union rate of 55% and avascular necrosis incidence of 50%.²⁶ The direction of the fracture line and additional ligamentous injury affect stability, with horizontal-diagonal fractures having a better prognosis than vertical-diagonal fractures.²⁷ Operative management options include percutaneous methods or open reduction internal fixation with cannulated screws.^{28 29}

A meta-analysis by Symes and Stothard comparing operative to conservative management of acute scaphoid fracture calculated the rate of non-union to be three times less in the group undergoing surgery. In the medium term, range of movement and grip strength were also significantly better in those managed

Figure 2 Magnetic resonance images from sequential frames of the same scan showing two separate non-displaced fractures running across the scaphoid.

operatively, with an associated faster return to productivity for the individual. These apparent benefits in surgical fixation are transient, with no significant differences in the two approaches after a year. In the group managed with surgery, there was a significantly higher rate of complications such as complex regional pain syndrome, requirement for subsequent removal of screws and problems with scarring.³⁰

There has only been one previously reported case of a segmental fracture of the scaphoid. In the case by da Assunção *et al*, the fracture pattern was identified as segmental only intra-operatively.³¹ The fracture was fixed with a single Herbert screw and union was achieved 12 months postoperatively. In this case and our own, initial radiographs were interpreted as a fracture through the scaphoid waist. This illustrates the importance of further imaging with MRI in diagnosing occult scaphoid fractures.

Learning points

- The scaphoid is the most frequently fractured carpal bone and when poorly managed can lead to non-union or malunion with significantly reduced function.
- On plain radiographs, fracture lines can be difficult to assess. It is important to consider the use of other imaging modalities to identify fractures and define their morphology.
- The scaphoid fracture pattern is important to establish as it is central to management decision-making.
- CT imaging is the gold standard to assess fracture morphology in detail. MRI with gadolinium enhancement is the best modality to diagnose occult fractures and avascular necrosis.

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REFERENCES

- 1 Alshryda S, Shah A, Odak S, *et al*. Acute fractures of the scaphoid bone: systematic review and meta-analysis. *Surgeon* 2012;10:218–29.
- 2 McNally C, Gillespie M. Scaphoid fractures. *Emerg Nurse* 2004;12:21–5.
- 3 Tysver T, Jawa A. Fractures in brief: scaphoid fractures. *Clin Orthop Relat Res* 2010;468:2553–5.
- 4 Haisman JM, Rohde RS, Weiland AJ. Acute fractures of the scaphoid. *J Bone Joint Surg Am* 2006;88:2750–8.
- 5 Leslie IJ, Dickson RA. The fractured carpal scaphoid. Natural history and factors influencing outcome. *J Bone Joint Surg Br* 1981;63-B:225–30.
- 6 Szabo RM, Manske D. Displaced fractures of the scaphoid. *Clin Orthop Relat Res* 1988;230:30–8.
- 7 Steinmann SP, Adams JE. Scaphoid fractures and nonunions: diagnosis and treatment. *J Orthop Sci* 2006;11:424–31.
- 8 Smith M, Bain GI, Turner PC, *et al*. Review of imaging of scaphoid fractures. *ANZ J Surg* 2010;80:82–90.
- 9 Gelberman RH, Menon J. The vascularity of the scaphoid bone. *J Hand Surg Am* 1980;5:508–13.
- 10 Herbert TJ, Fisher WE. Management of the fractured scaphoid using a new bone screw. *J Bone Joint Surg Br* 1984;66:114–23.
- 11 Green DP HR, Pederson WC, Wolfe SW. *Green's operative hand surgery*. Philadelphia: Elsevier, 2005:2313.
- 12 Rubin DA DR. Expert panel on musculoskeletal imaging. *Acute Hand and Wrist Trauma* 2005.
- 13 Hunter JC, Escobedo EM, Wilson AJ, *et al*. MR imaging of clinically suspected scaphoid fractures. *AJR Am J Roentgenol* 1997;168:1287–93.
- 14 Waizenegger M, Barton NJ, Davis TR, *et al*. Clinical signs in scaphoid fractures. *J Hand Surg Br* 1994;19:743–7.
- 15 Yin ZG, Zhang JB, Kan SL, *et al*. Diagnostic accuracy of imaging modalities for suspected scaphoid fractures: meta-analysis combined with latent class analysis. *J Bone Joint Surg Br* 2012;94:1077–85.
- 16 Dorsay TA, Major NM, Helms CA. Cost-effectiveness of immediate MR imaging versus traditional follow-up for revealing radiographically occult scaphoid fractures. *AJR Am J Roentgenol* 2001;177:1257–63.
- 17 Perlík PC, Guilford WB. Magnetic resonance imaging to assess vascularity of scaphoid nonunions. *J Hand Surg Am* 1991;16:479–84.
- 18 Trumble TE. Avascular necrosis after scaphoid fracture: a correlation of magnetic resonance imaging and histology. *J Hand Surg Am* 1990;15:557–64.
- 19 Nakamura R, Imaeda T, Horii E, *et al*. Analysis of scaphoid fracture displacement by three-dimensional computed tomography. *J Hand Surg Am* 1991;16:485–92.
- 20 Bain GI, Bennett JD, Richards RS, *et al*. Longitudinal computed tomography of the scaphoid: a new technique. *Skeletal Radiol* 1995;24:271–3.
- 21 Fusetti C, Poletti PA, Pradel PH, *et al*. Diagnosis of occult scaphoid fracture with high-spatial-resolution sonography: a prospective blind study. *J Trauma* 2005;59:677–81.
- 22 Hodgkinson DW, Nicholson DA, Stewart G, *et al*. Scaphoid fracture: a new method of assessment. *Clin Radiol* 1993;48:398–401.
- 23 Modi CS, Nancoo T, Powers D, *et al*. Operative versus nonoperative treatment of acute undisplaced and minimally displaced scaphoid waist fractures—a systematic review. *Injury* 2009;40:268–73.
- 24 Buijze GA, Doornberg JN, Ham JS, *et al*. Surgical compared with conservative treatment for acute nondisplaced or minimally displaced scaphoid fractures: a systematic review and meta-analysis of randomized controlled trials. *J Bone Joint Surg Am* 2010;92:1534–44.
- 25 Dias JJ, Wildin CJ, Bhowal B, *et al*. Should acute scaphoid fractures be fixed? A randomized controlled trial. *J Bone Joint Surg Am* 2005;87:2160–8.
- 26 Dabezies EJ MR, Faust DC. Injuries to the carpus: fracture of the scaphoid. *Orthopedics* 1982;5:1510–21.
- 27 Schaefer M, Siebert HR. [Fracture of the semilunar bone]. *Unfallchirurg* 2002;105:540–52; quiz 52–3.
- 28 Rettig AC, Kollas SC. Internal fixation of acute stable scaphoid fractures in the athlete. *Am J Sports Med* 1996;24:182–6.
- 29 Strelí R. [Percutaneous screwing of the navicular bone of the hand with a compression drill screw (a new method)]. *Zentralbl Chir* 1970;95:1060–78.
- 30 Symes TH, Stothard J. A systematic review of the treatment of acute fractures of the scaphoid. *Journal of Hand Surgery* 2011;36:802–10.
- 31 da Assunção RE, Yates P, Hargreaves DG. Segmental fracture of the scaphoid: report of a rare fracture pattern. *Arch Orthop Trauma Surg* 2005;125:479–81.

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