Review of the current methods in the diagnosis and treatment of scaphoid fractures

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Abstract

If neglected or misdiagnosed, non-union of a scaphoid fracture will almost inevitably progress to radiographic and symptomatic osteoarthritis of the wrist with subsequent morbidity and lifelong disability, especially in young males in which the fracture is more common. Fractures of the scaphoid bone are the most common fractures of the carpus and second in occurrence among fractures of the wrist.

The diagnosis and treatment are not simple. Familiarity with different imaging methods and treatment options is required. The treatment in most cases is conservative and will lead to uneventful union, but an operation may be needed in certain cases primarily and in the treatment of non-union.

The current literature on the diagnosis and treatment of scaphoid fractures is reviewed, and the authors try to make a clear and concise picture of this complex and sometimes controversial field.

(*Postgrad Med J* 2001;77:235–237)

Keywords: scaphoid; fracture

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Submitted 15 March 2000
Accepted 31 October 2000

Fractures of the scaphoid are the most common fractures of the carpus. Cousin and Destor originally described fractures of the scaphoid in 1889, as a fracture typical to young adults falling on an outstretched hand during sporting activity. This type of fracture is rare in children and elderly persons. Children will usually fracture the distal radial epiphysis and old people will commonly fracture the distal radius.[1 2]

The scaphoid serves as a bridge between the proximal and the distal carpal bones and transfers compression loads from the hand to the forearm and it has a major role in maintaining carpal stability.

Most of the blood supply derives from branches of the radial artery that penetrate the scaphoid distally and supply 70%–80% of the more proximal bone, thus giving rise to the problem of a higher rate of non-union and avascular necrosis in more proximal fractures. There is a rare accessory bone (os centrale carpi) that can resemble a fracture. It can be differentiated from a fracture by its rounded edges and lack of degenerative changes as in the case of an old fracture.[3]

Fractures of the scaphoid are usually caused by forcible extension of the wrist, though flexion and compression mechanisms are also described in the literature.[1 4]

Clinical picture and natural history

The classical signs of a scaphoid fracture are tenderness and swelling in the anatomical snuffbox and on the scaphoid tubercle. Recently the sensitivity and specificity of those signs were examined. Though the signs are extremely sensitive (100%) they are not specific (snuffbox tenderness 9% specificity, scaphoid tubercle tenderness 30% specificity). Tenderness on thumb movement was found to be the most specific physical finding (48% specificity). The three signs combined after 24 hours were 74% specific.[5]

Lindstrom and Nystrom analysed the natural history of neglected scaphoid fractures.[6] They found that 100% of patients developed radiographic osteoarthritis, mostly of the radiocarpal joint. Almost all the patients had clinical osteoarthritis at the end of follow up. The authors concluded that asymptomatic non-union of the scaphoid would almost inevitably cause deterioration clinically and radiographically with time.

Diagnosis and imaging

Standard four or six view series of the wrist should be ordered.[7 8] Most of the fractures can be diagnosed primarily if good quality radiographs are obtained (fig 1).[7 8] If the clinical picture is suggestive of a scaphoid fracture and no fracture can be demonstrated on radiography, the patient should be treated as if he had a fracture.[1 2] The radiographs should be repeated in 2–3 weeks.[1] Delayed diagnosis can lead to higher rates of non-union.[4] It is essential

Figure 1 An acute displaced waist fracture of the scaphoid (arrow).

Figure 2 A two month old neglected waist fracture (arrow), typical sclerosis, and bone resorbtion of the fracture edges.

to discriminate between an acute fracture and an asymptomatic non-union, which had been worsened by a new trauma. The classical signs of non-union are bone resorbtion at the fracture edges, subchondral sclerosis, and displacement on both anteroposterior and lateral films (fig 2).

Several common radiograph findings can be misinterpreted and lead to a false positive diagnosis of a fracture (fig 3): a dark line that represents the dorsal lip of the radius, a white line that is made by the proximal side of the scaphoid tuberosity, and the dorsal ridge can seem like a fracture in a semisupinated view.[1 4]

A technetium bone scan can be helpful when repeated radiographs are not diagnostic. It is highly sensitive but not at all specific. A normal bone scan practically excludes a fractured scaphoid, but a positive scan is only 92% specific.[9]

Figure 3 Artifacts that can resemble a fracture: Mach effect (a dark line that represents the dorsal lip of the radius) (black arrow), a white line that represents the proximal side of the scaphoid tuberosity (white arrow). An old un-united fracture of the ulnar styloid can also be seen.

Computed tomography and magnetic resonance imaging (MRI) scans can demonstrate a fracture line when other diagnostic modalities are inconclusive. Hunter *et al* performed MRI on wrists of patients with a clinical picture compatible with a scaphoid fracture and negative radiographs. In 22 of 36 patients occult fractures were found.[10]

Classification

Scaphoid fractures can be classified according to location, for example, tuberosity, distal one third, waist, proximal one third, and an osteochondral fracture and by stability. A non-displaced fracture is considered stable. It usually develops by compression mechanism.[1] The fracture is considered unstable if there is displacement more than 1 mm on any view or if there is movement of the fracture fragments on dynamic fluoroscopy. A scapholunate angle more than 60° or a lunocapitate angle more than 15° also make the fracture unstable.[1 2]

Primary treatment

Traditionally most of the acute scaphoid fractures were treated by a below elbow cast, which included immobilisation of the thumb (scaphoid cast). Recent work demonstrated that immobilisation of the thumb did not influence union rates and a "Colles" type cast can be used safely.[4] We still use a traditional scaphoid cast, leaving the interphalangeal joint of the thumb free.

In cases of a clinical suspicion of a fracture the plaster should be removed after 2–3 weeks and new radiographs should be ordered.[1] Other authors believe that a bone scan is more sensitive for the diagnosis of the occult scaphoid fracture and it can be performed earlier to exclude a fracture and remove the unnecessary cast.[11] We routinely do bone scans a week after injury in unclear cases to prevent complications of prolonged unnecessary casting.

The length of the cast is controversial. In continental Europe and the US a below elbow cast is used to treat a stable or a more distal fracture. An above elbow cast is used for an unstable or a more proximal fracture.[1 2] In the UK a below elbow cast is used in any case.[4] We almost always use a below elbow cast and an above elbow cast occasionally. The position of the hand in plaster is also controversial. Some authors propose some ulnar deviation and no wrist flexion or extension as the most logical position.[1] In a recent paper no difference in union rates was found between wrists immobilised in 20° flexion or 20° extension, but the wrists immobilised in flexion had greater restriction of extension after six months.[12] The position probably doesn't matter as long the wrist is immobilised.[4]

There also is no agreement in the literature on the period of casting. Barton recommends putting a cast for eight weeks and a clinical and radiographic examination afterwards.[4] If there is tenderness in the snuffbox or the radiographs are dubious the patient goes back into plaster for another four weeks.[4] After that the plaster is always removed, and clinical follow up is

continued. We follow the same practice as Barton on this matter. Assessment of union can be extremely difficult, sometimes even at operation with the bone in front of the surgeon's eyes.[4] Computed tomography and MRI can be used when repeated clinical and radiographic examinations are inconclusive.

Unstable fractures or fracture dislocations (trans-scaphoid perilunate dislocation) are an accepted indication for an operation.[2] It is still common practice to reduce an unstable fracture and to use a plaster cast if a good reduction is obtained.[1] Operative fixation can be obtained by closed or open reduction and fixation by Kirschner wires or compression screws (AO or Herbert). Postoperatively the hand is placed in a below elbow or an above elbow cast for variable periods of time, depending on the surgeon's preference. The advantage of the compression screws is the ability to achieve earlier movement of the wrist.[1]

Delayed union and non-union

Many definitions of delayed union and non-union exist, and no one definition is perfect. The most practical definition in our opinion is if there is no progression of healing on three separate monthly radiographs, after six months of treatment; we know, however, that some of these patients will progress to union without an operation.[2 4] It is accepted that operative treatment is recommended for non-union even if it is asymptomatic in order to prevent carpal osteoarthritis.[1 2 4] There are four major principles of treatment:

(1) Preservation of blood supply.
(2) Bone grafting to achieve the original alignment.
(3) Stable internal fixation.
(4) Correction of carpal instability.

Russe bone graft is the standard operation for scaphoid non-union. Originally it was done by a volar approach. Matti developed a dorsoradial approach that is more popular today; 97% union rates can be achieved by this method.[1] Technically, all avascular bone and fibrotic tissue are removed. A corticocancellous or a double cortical graft is prepared from the iliac crest or the radius and placed to bridge the fracture. Internal fixation is usually used. The operation is not recommended when a small distal fragment is completely avascular. In cases of secondary non-union a repeat bone graft is recommended, and good results can be achieved.[13 14] Several salvage procedures for neglected cases were developed over the years. A radial styloidectomy can be useful for the treatment of radiocarpal arthrosis in scaphoid non-union. A partial or total scaphoidectomy is not accepted practice today (excluding a small proximal fragment). In severe cases of arthrosis a proximal carpectomy or a partial carpal arthrodesis can be performed.[1 2]

Paediatric fractures

Scaphoid fractures are uncommon and difficult to diagnose in children. Those are usually non-displaced distal pole fractures.[15] Some authors report a significant rate of false negative radiographs but, on the contrary, in a recent review of 33 paediatric scaphoid fractures 97.3% were evident on the initial radiographs.[16] The treatment is the same as in adults: plaster in stable fractures and operation in unstable or irreducible using the same criteria as in adults. In the above mentioned study all fractures went to union at a mean of 7.1 weeks.[16] Non-union is rare but can be managed as in adults by a bone graft with or without some method of internal fixation with excellent results.[15 16]

Arthroscopy

Several new studies report the results of arthroscopically assisted reduction of unstable scaphoid fractures. This method enables an accurate reduction with a minimal surgical trauma and earlier movement of the hand. We don't have experience with this technique. There are not enough data yet to compare long term results to standard methods.[17]

Conclusion

Fractures of the scaphoid are widespread and many times are difficult to diagnose and treat. They can cause prolonged morbidity and absence from work in young adults in which they are the most common. Even the primary treatment demands expertise and familiarity with different treatment options. If these requirements are met, a good prognosis can be expected.

1 Cooney WP, Linscheid RL, Dobyns JH. Fractures and dislocations of the wrist. In: Rockwood CA, *et al*, eds. *Fractures in adults*. 4th Ed. Philadelphia: Lippincott-Raven, 1996: 745–67.
2 Sampson SP, Wisch D, Akelman E. Fractures and dislocations of the hand and wrist. In: Dee R, *et al*, ed. *Principles of orthopaedic practice*. 2nd Ed. New York: McGraw-Hill, 1997: 429–42.
3 Yang ZY, Gilula LA, Jonsson K. Os centrale carpi simulating a scaphoid waist fracture. *J Hand Surg [Br]* 1994;**19**:754–6.
4 Barton NJ. Twenty questions about scaphoid fractures. *J Hand Surg [Br]* 1992;**17**:289–309.
5 Parvizi J, Wayman J, Kelly P, *et al*. Combining the clinical signs improves diagnosis of scaphoid fractures. A prospective study with follow-up. *J Hand Surg [Br]* 1998;**23**:324–7.
6 Lindstrom G, Nystrom A. Natural history of scaphoid non-union, with special reference to "asymptomatic" cases. *J Hand Surg [Br]* 1992;**17**:697–700.
7 Leslie IJ, Dickson RA. The fractured carpal scaphoid. Natural history and factors inflencing outcome. *J Bone Joint Surg Br* 1981;**63**:225–30.
8 Mehta M, Brautigan MW. Fracture of the carpal navicular—efficacy of clinical findings and improved diagnosis with six-view radiography. *Ann Emerg Med* 1990;**19**:255–7.
9 Murphy DG, Eisenhauer MA, Powe J, *et al*. Can a day 4 bone scan accurately determine the presence or absence of scaphoid fracture? *Ann Emerg Med* 1995;**26**:434–8.
10 Hunter JC, Escobedo EM, Wilson AJ, *et al*. MR imaging of clinically suspected scaphoid fractures. *AJR Am J Roentgenol* 1997;**168**:1287–93.
11 Tiel-van Buul MM, van Beek EJ, Borm JJ, *et al*. The value of radiographs and bone scintigraphy in suspected scaphoid fracture. A statistical analysis. *J Hand Surg [Br]* 1993;**18**: 403–6.
12 Hambidge JE, Desai VV, Schranz PJ, *et al*. Acute fractures of the scaphoid. Treatment by cast immobilisation with the wrist in flexion or extension? *J Bone Joint Surg Br* 1999;**81**: 91–2.
13 Bynum EB, Culp RW, Bonatus TJ, *et al*. Repeat Russe bone grafting after failed bone graft surgery for scaphoid non-union. *J Hand Surg [Br]* 1995;**20**:373–8.
14 Inoue G, Kuwahata Y. Repeat screw stabilization with bone grafting after a failed Herbert screw fixation for acute scaphoid fractures and nonunions. *J Hand Surg [Am]* 1997; **22**:413–18.
15 Mintzer CM, Waters PM. Surgical treatment of pediatric scaphoid fracture nonunions. *J Pediatr Orthop* 1999;**19**:236–9.
16 Wulff RN, Schmidt TL. Carpal fractures in children. *J Pediatr Orthop* 1998;**18**:462–5.
17 Whipple TL. Stabilization of the fractured scaphoid under arthroscopic control. *Orthop Clin North Am* 1995;**26**:749–54.