

Osteonecrosis of the Distal Pole of the Carpal Scaphoid Following Fracture – A Rare Complication

Seth B. Sherman, M.D.¹, Adam Greenspan, M.D.^{2, 3}, and Alex Norman, M.D.^{2, 3}

¹ SUNY Downstate Medical Center, Kings County Hospital, Brooklyn, New York, USA

² Mt. Sinai School of Medicine of CUNY, New York, New York, USA

³ Hospital for Joint Diseases Orthopaedic Institute, New York, New York, USA

Abstract. A case of carpal scaphoid fracture followed by osteonecrosis of the distal fragment alone is presented.

Key words: Carpal scaphoid fracture – Osteonecrosis – Nonunion of scaphoid fracture

Osteonecrosis is a well-known complication of scaphoid fracture. It generally involves the proximal fragment, although occasionally both fragments may become necrotic. A case of scaphoid fracture complicated by necrosis of the distal pole is presented because of its rarity. No similar case could be found in the literature.

Case Report

A 40-year-old man injured his left wrist in an industrial accident. The initial radiograph, which has been lost, showed a fracture through the waist of the scaphoid (without dislocation) and a fracture of the radial styloid. The patient's wrist was first immobilized with a splint; subsequently, a short cast was applied for three months. At that time, the wrist was examined radiographically and a cast was re-applied because of the lack of healing. However, the patient's discomfort persisted. A radiograph taken seven months after the injury showed that the radial styloid fracture had healed, but that there was nonunion of the scaphoid fracture with osteonecrosis of the distal fragment and traumatic arthritis of the radiocarpal joint (Fig. 1 A and B). Surgical treatment was suggested, but the patient refused.

Discussion

Carpal injuries account for approximately 2% of all fractures and dislocations [3]. Fracture of the scaphoid bone is the most common (51%–62%)

[2–4, 11]. Young males have the highest number (83%–95% [1, 4, 5, 8] and there is a predilection for the right wrist (49%–70%). Only 3% are bilateral; about 5% are associated with dislocation.

Fractures of the scaphoid are classified according to their location in the bone: 15%–20% are in the proximal pole, 70%–84% in the waist, and 5%–10% in the distal pole [4, 5, 8]. The incidence of osteonecrosis as a complication is generally low (10%–15%) [5, 6]. However, when nonunion occurs it increases to 30%–40% [4, 6, 9]. Osteonecrosis is most common when there is displacement of the fragments [6]. Other complications associated with scaphoid fracture include post-traumatic arthritis (30%–35%) [4, 5, 7], delayed union or nonunion (33%–37%) [1, 2, 4–9], cyst formation (40%) [1, 7], and occasionally infection.

Osteonecrosis of the scaphoid is recognized when the fragment becomes sclerotic (most frequently 6–9 months after injury) (Figs. 2 and 3). In the process of repair, the necrotic fragment may structurally weaken and collapse. Early, there is no radiographic evidence of joint narrowing or arthritis.

The carpal scaphoid articulates with the lunate, capitate, trapezium, trapezoid, and radius and is firmly secured to these structures by ligamentous attachment. A narrow, rough ridge runs obliquely around the dorsal surface of the bone from the tuberosity on the lateral side to the base which is proximal and medial. The blood supply passes through the foramina which perforate this ridge. This is the critical segment of the bone [15] (Fig. 4).

When osteonecrosis occurs as a complication of scaphoid fracture it depends on the nature of the trauma and the distribution of the blood vessels. The normal extra-osseous vascular supply to the scaphoid comes from the radial artery via the superficial palmar and palmar carpal branches

Address reprint requests to: Alex Norman, M.D., Hospital for Joint Diseases, Orthopaedic Institute, 301 East 17th Street, New York, NY 10003, USA

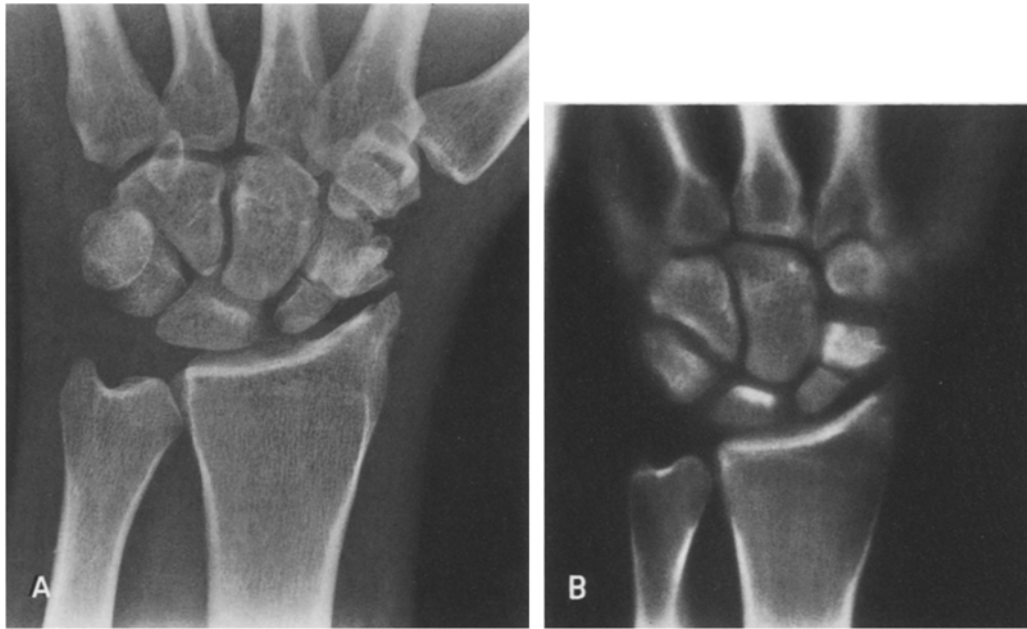


Fig. 1. **A** There is a fracture through the waist of the scaphoid. The distal fragment is dense and characteristic of osteonecrosis. Note the healed fracture of the radial styloid, the traumatic arthritis of the radiocarpal joint, and the odd configuration of the scaphoid fragment which could be due to a comminuted fracture. **B** Tomogram demonstrates osteonecrosis of the distal fragment. The sharp “cut-off” of the distal segment is a technical artifact always found in trispiral (thin section 1.0 mm) tomography



Fig. 2. The typical complication of scaphoid fracture showing nonunion and osteonecrosis of the proximal fragment

Fig. 3. Tomogram of the wrist demonstrates osteonecrosis of both fragments of the scaphoid. This is an unusual finding, particularly in children or adolescents. This patient was 12 years of age

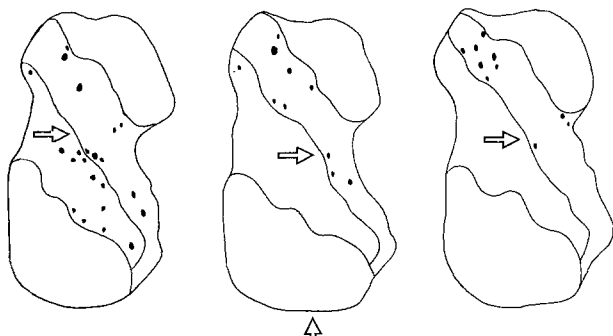


Fig. 4. Schematic presentation of variation in the entry site of the blood vessels in the carpal scaphoid (modified after Watson-Jones Ref. 15). Note that the arterial foramina are distributed along the ligamentous ridge (arrow). The arrowhead points to the proximal pole

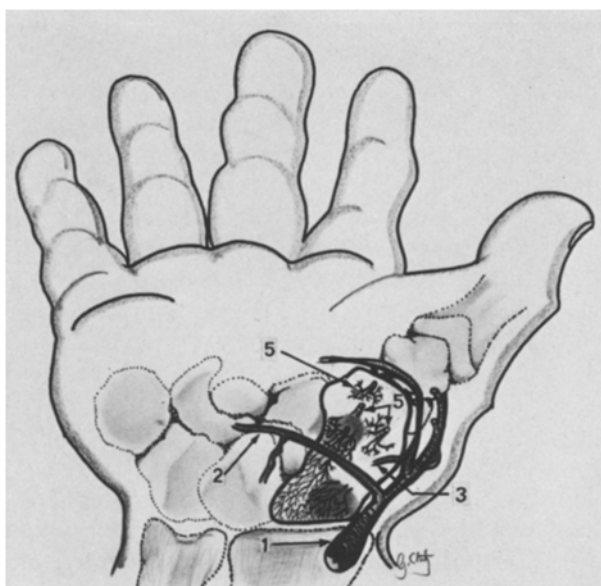


Fig. 5. Extra-osseous and intra-osseous blood supply of the scaphoid (modified after Taleisnik and Kelly [13]. (1) Radial artery, (2) lateral palmar vessels, (3) dorsal vessel, (4) distal vessel, (5) latero-palmar vessels

[13] (Fig. 5). Of the three groups of vessels branching from the main artery, the lateral palmar group is the most important. Branches of the lateral palmar vessels may arise from the radial artery or the superficial palmar branch or both. These are joined by a dorsal group from the superficial palmar branch. Two to four vascular branches enter the foramina in the oblique ridge and terminate in arcades within the scaphoid. Most nutrient vessels course proximally and supply the proximal two-thirds of the scaphoid. The distal group of vessels supply the carpal tuberosity and part of the trapezium. In a study by Taleisnik and Kelly an accessory proximal artery arose from the

palmar carpal branch and entered the scaphoid near its articulation with the lunate in one of 11 specimens [13]. Oblatz and Halbstein examined 297 specimens and found the blood supply to the proximal pole of the scaphoid precarious in 33% [10].

How can one explain osteonecrosis limited to the distal fragment after a fracture through the waist of the scaphoid as in this patient? Possibly, the blood supply of the scaphoid was anomalous, that is, deficient vascularization of the distal pole and an aberrant vessel to the proximal fragment. Perhaps comminution of the fragment contributed to osteonecrosis. Dislocation favors the occurrence of osteonecrosis and although there was no recognizable dislocation, it may have occurred and spontaneously reduced [4, 12, 14, 16].

References

1. Andersen K, Therkelsen F (1949) On fractures of the carpal bones, especially of the scaphoid. *Acta Radiol [Diag.] (Stockh)* 31:343
2. Bohler L (1956) *The treatment of fractures*, 5th edn. Grune and Stratton New York, p 882
3. Cave EF, Boyd RJ (1974) In: Cave EF, Burke JF, Boyd RJ (eds) *Trauma management*, 1st edn. Year Book Medical Publishers Chicago, p 527
4. DePalma AF (1970) *The management of fractures and dislocations - An atlas*, 2nd edn. WB Saunders, Philadelphia, p 956
5. Dickinson JC, Shannon JG (1944) Fractures of the carpal scaphoid in the Canadian Army. *Surg Gynecol Obstet* 79:225
6. Graham J, Wood S (1976) In: Davidson JK (ed) *Aseptic necrosis of bone*, 1st edn. Excerpta Medica, Amsterdam, p 101
7. Mazet R, Hohl M (1963) Fractures of the carpal navicular. *J Bone Joint Surg [Am]* 45:82
8. McLaughlin HL, Parkes JC (1963) A statistical review of 100 cases of fracture of the carpal navicular. *Clin Orthop* 31:102
9. Milford L (1980) In: Edmonson AS, Crenshaw AH (eds) *Campbell's operative orthopaedics*. CV Mosby, St Louis, p 110
10. Oblatz BE, Halbstein BM (1938) Nonunion of fractures of the carpal navicular. *J Bone Joint Surg [Am]* 20:424
11. Osterman AL, Bora FW (1980) In: Heppenstall RB (ed) *Fracture treatment and healing*, 1st edn. WB Saunders, Philadelphia, p 504
12. Russell TB (1949) Intercarpal dislocations and fracture-dislocations. *J Bone Joint Surg [Br]* 31:524
13. Taleisnik J, Kelly PJ (1966) The extraosseous and intraosseous blood supply of the scaphoid bone. *J Bone Joint Surg [Am]* 48:1125
14. Wagner CJ (1959) Fracture-dislocations of the wrist. *Clin Orthop* 15:181
15. Wilson JN (1976) *Watson-Jones fractures and joint injuries*, vol 2, 5th edn. Churchill Livingstone, Edinburgh London New York, p 735
16. Vaughan-Jackson OJ (1949) A case of recurrent subluxation of the carpal scaphoid. *J Bone Joint Surg [Br]* 31:532