Updated Management of Undisplaced Scaphoid Fractures

Faraj Said Faraj Ashmylh *, Adel Mohamed Salama, Amr Mohamed Eladawy, Salah Mahmoud Abd Elkader
Orthopedic Surgery Department, Faculty of Medicine, Zagazig University Zagazig, Egypt.

Corresponding Author: Faraj Said Faraj Ashmylh
Email: Frjashmylh45@gmail.com

Abstract
Scaphoid fractures most commonly result from a fall on an outstretched hand with the wrist in extension and radial deviation. The exact biomechanical mechanism of the fracture has been debatable. Three common classifications used for scaphoid fracture include the Mayo classification, the Russe classification, and the Herbert classification. Early diagnosis of scaphoid fractures is essential to avoid their complications like nonunion and Avascular necrosis (AVN). The aim of management of scaphoid fractures is to achieve fracture consolidation, functional recovery and to avoid the possible complications such nonunion, and osteonecrosis. Therapeutic options consist of cast immobilization and operative management.

Key words: Undisplaced Scaphoid Fractures

Anatomy of scaphoid
Surface Anatomy
The scaphoid lies at ~45 degrees to the long axis of the wrist in both the radial and palmar directions(1). The scaphoid tubercle is located at the base of the thenar eminence, in line with the radial border of the long finger. The tubercle extends volarward and is more readily palpable with the wrist dorsiflexed in radial deviation(2). The waist can be palpated between the radial styloid and the base of the trapezium in the anatomical snuffbox. The proximal pole can be palpated on the dorsum, distal to and in line with Lister’s tubercle

Fig (1): Anatomical snuffbox is revealed better with the wrist in ulnar deviation. (A) X-ray of wrist in ulnar deviation, B) clinical photograph of wrist in ulnar deviation. Landmarks are—(3) radial styloid, (4) waist of scaphoid, (5) trapezium, (6) base of the first metacarpal

Scaphoid osseous anatomy
The word scaphoid is derived from the Greek word (skaphos) for boat; it has unique anatomy regarding the surrounding carpal bones, being oriented on an oblique long axis, acting as a mechanical link between the distal and proximal carpal rows. Almost 75% of the scaphoid surface area is covered with articular cartilage, except the volar surface being partially uncovered

Four different anatomic regions of the scaphoid can be described:
(1) the tubercle, (2) the waist, (3) the proximal pole, and (4) the distal pole
The tubercle:
The tubercle directed radially and volarly. It is the site of attachment of scaphotrapezial and scaphotrapezoidal ligaments, being partially covered by the tendon of flexor carpi radialis. (10)(12)

Scaphoid Waist
The waist serves as a site for ligamentous attachments.(4,5) for joint capsule attachment and for the passage of nutrient vessels from the radial artery proper or dorsal radiocarpal arch into the scaphoid via numerous dorsal foramina.(6,7)

A morphological analysis of the scaphoid by Fogg(8)suggests that there are variations in the morphology of the scaphoid that can be classified into two types. A type 1 (rotating) scaphoid is characterized by a single high crest obliquely oriented across the dorsal aspect of the waist; the type 2 (flexing) scaphoid is characterized by three low crests similarly oriented and located. These ridges correspond to the attachment of the dorsal joint capsule and, importantly, the dorsal intercarpal ligament and fibres of the radioscaphocapitate ligament radially.

The proximal pole:
It articulates with the scaphoid fossa of the distal radius. Along the ulnar border of the proximal end, the scaphoid articulates proximally with the lunate bone and distally with the capitate bone.(3)(9)

The distal pole:
Is the site of articulation with the trapezoid and trapezium.(10)

The dorsoradial ridge:
Is a narrow, non-particular area with multiple vascular foramina to perfuse the scaphoid bone, separating the dorsal and proximal surfaces from the distal volar surface. (10)

Scaphoid injuries can be ligamentous, such as perilunate instability which is also called dorsal intercalated segment instability (DISI) or can involve fracture of the bone with or without ligamentous injury.(11)

Scaphoid fractures most commonly result from a fall on an outstretched hand with the wrist in extension and radial deviation.(12) The exact biomechanical mechanism of the fracture has been debatable. Todd was the first to study the mechanism of scaphoid fractures and he believed that they occur due to excessive tension,(13) whereas Cobey and White argued that scaphoid fractures result from excessive compression along the scaphoid’s concave medial articulation surface with the capitate.(14)
Management of scaphoid fractures
The aim of management of scaphoid fractures is to achieve fracture consolidation, functional recovery and to avoid the possible complications such nonunion, and osteonecrosis. Therapeutic options consist of cast immobilization and operative management(16).

Non operative (Cast immobilization):
Done by Short arm thumb spica cast With 20˚ dorsiflexion of the wrist, leaving the inter phalangeal joint of the thumb free seems to have a positive effect on the grip strength, range of motion ,and the time to union (85% vs. 70%) measured by CT at 10 weeks in patients treated without thumb immobilization. (17)
There no significant differences in union rate have been noted with long arm or short arm thumb spica casts.(17)
Immobilization should continue until there are clinical and radiographic signs of bony union. (17)
Scaphoid waist fractures usually heal within (8- 12weeks) while distal pole fractures heal fastest within (6- 8 weeks), and proximal pole fractures the slowest heal within (12 -24 weeks).
CT scans should be ordered to assess healing. If the CT showed unhealed fracture, cast immobilization is maintained for another 4 - 6 weeks.(17)

Indication:
- Non-displaced fractures.
- Distal pole or tubercle fractures.
- Displacement is difficult to determine based on plain radiographs, so CT scan should be ordered to ensure that a fracture is truly non-displaced.(18)

Disadvantages of non-operative treatment:
Cast immobilization in not rigid fixation enough to prevent occurrence of micro motion at the fracture site, this leads to an increased rate of nonunion especially in unstable fractures. (19)
Long periods of cast immobilization more than 12 weeks result in disuse osteopenia, stiffness and muscle atrophy that requires a longer rehabilitation time and loss of gainful employment with significant economic burden especially in athletes. (20)
Frequent office visits are needed for monitoring of skin condition, cast fitting, and radiological
assessment for fracture alignment. (20)

**Operative treatment:**

**Indications:**
- Displaced waist fractures.
- Non-displaced scaphoid fractures in young active individuals.
- Fractures with loss of carpal alignment.
- Proximal pole fractures. (21)

**Methods:**
1. Percutaneous pinning (volar or dorsal).
2. Open approach (volar or dorsal).
3. Arthroscopic assisted approach. (21)

The choice of the approach depends on the fracture pattern, chronicity of fracture, bone loss, and vascularity of the proximal pole. (21)

**Technique**

**Different Screw designs:**
The development of new headless compression screws (HCSs) for scaphoid fixation is rapidly growing, with each screw has its own mechanism of building compression. (22)

**Acumed Acutrak 2 Mini:**
Has a conical shape with continuous variable threads. The wide thread pitch at the tip of the screw penetrates the bone faster than the fine thread pitch at the end, resulting in gradual compression of the two bony fragments. (22)

**Stryker TwinFix:**
Has proximal and distal threads that work independently resulting in insitu dynamic interfragmentary compression. (22)

**Synthes 3.0 HCS:**
Has a unique instrument a compression sleeve that brings the bony fragments together allowing for accurate placement of the screw under the surface cartilage. (22)

**KLS Martin HBS 2 Midi:**
Has a different proximal and distal pitch to allow for interfragmentary compression. (22)

Dominik Gruszka et al. studied four modern HCSs. The aim of this study was to assess the impact of different screw design on stability of scaphoid fixation. The primary outcome depends on the degree of dislocation that occurs between the two bony fragments under cyclic loading. (22)

Dominik Gruszka, also reported that there is no statistically significant difference between the different screw designs regarding stability of scaphoid fixation. (22)

**Fig. (4):** Showing different screw designs, 1-Acumed Acutrak 2 Mini (AA), 2-Stryker TwinFix (ST), 3-Synthes 3.0 HCS with a long thread (SH), 4-KLS Martin HBS 2 Midi (MH).

**Volar Percutaneous Technique:**
Percutaneous fixation techniques with compression screws were used, as described in the study.
by Severo, A. Land Folberg et al. (23)

**Indications:**
Fractures of distal and middle thirds of the scaphoid.

**Technique:**
- **Position of the patient:**
The patient is placed in a supine recumbent position and under fluoroscopy. Then the wrist is placed in hyperextension and ulnar deviation. (23)

![Fig. (5): An image showing the position of the patient and the wrist under fluoroscopy.](24)

- **Reduction maneuver:**
Hyperextension brings the trapezium dorsal to the entry point for the guide wire "the scaphoid tubercle", While ulnar deviation slides the scaphoid out from the radial styloid process. (25)

- **guide wire insertion:**
Once the reduction is confirmed radiologically, a 1.1 mm percutaneous guidewire is inserted via the scaphoid tuberosity. The scaphoid lies in an oblique long axis by 45°, so the guidewire must be angled 45° medially and 45° dorsally, then the wire is advanced toward the center of the proximal pole. (25)

- **measuring screw length:**
The length of the screw is determined by a depth gauge or using an extra guidewire of the same length as shown in (26)

![Fig. (6): A diagram showing how to measure the screw length.](24)

- **Reaming:**
If the guidewire is in an appropriate position, an incision of 0.5 mm is made around the wire then a cannulated drill is passed through the guidewire to approximately 2mm from the articular surface of the proximal pole. (25)

- **Screw insertion:**
After reaming a compression screw of appropriate length is inserted under fluoroscopy till it is buried under the articular surface to avoid intra articular prominence. (25)
• Closure of the wound:

Dorsal Percutaneous Technique:
Percutaneous fixation techniques with compression screws were used, as described in the study by

References


