

Research Article

Correlation Between the Entry Point for Volar Percutaneous Scaphoid Fixation and Fracture Line

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Abstract

Introduction: The word scaphoid is derived from the Greek word (skaphos) for boat. Because of its unique anatomy it can articulate with all five surrounding bones (distal radius, os capitatum, os lunatum, os trapezium and os trapezoideum)⁽¹⁾. **Aim of The work:** The aim of this work is to assess the best appropriate distal screw entry zone in volar percutaneous headless compression screw fixation of acute scaphoid fracture to achieve the best screw (lay out or positioning) and proximal trajectory from co-axial and biomechanical point of view in addition to assessment of healing and functional outcome. **Patients and Methods:** After obtaining human ethical committee approval with registration number of 30 patients with acute scaphoid fractures (Herbert type B1 & B2) were recruited for a randomized comparative prospective study.

Keywords: word scaphoid, distal radius, os capitatum, os lunatum, os trapezium and os trapezoideum

Introduction

The word scaphoid is derived from the Greek word (skaphos) for boat. Because of its unique anatomy it can articulate with all five surrounding bones (distal radius, os capitatum, os lunatum, os trapezium and os trapezoideum)⁽¹⁾.

Scaphoid fracture was first described in 1905 by Destot, a French surgeon, anatomist and radiologist. Scaphoid fractures account for 2.9% of all fractures and 69% of all carpal injuries that occur in the adult population; In fractures around the wrist, they came second in frequency only to distal radius fractures⁽²⁾.

Scaphoid fractures are commonly seen in the young and healthy, and are a rare finding in children or the elderly, where a fracture to the distal radius is more frequently seen. Early diagnosis of scaphoid fractures is critically owed to potential complications following the fracture, including non-union, avascular necrosis, carpal instability and osteoarthritis⁽³⁾.

According to the location of the fracture, scaphoid fractures involve the waist, proximal pole and distal pole in 70%, 20% and 10%⁽⁴⁾. In general, the prognosis of distal fractures is often

better than that for proximal fractures, because of the retrograde blood supply to the scaphoid⁽⁵⁾.

Scaphoid fractures can be isolated or associated with other concomitant injuries to ligamentous

and/or osseous structures around the wrist joint, such as perilunate fracture dislocation, fractures of the distal radius, fractures of other carpal bones⁽⁶⁾. The natural history of an isolated scaphoid fracture is associated with prolonged time to union and a mean non-union rate of up to 10%⁽⁷⁾. Proximal third fractures require the longest time to heal both clinically and radiographically and are associated with prolonged periods of cast immobilization and nonunion rates up to 33%⁽⁸⁾. Time to union may take as long as 6 months in some cases⁽⁷⁾.

Scaphoid bone is known to play a key role in the function of the wrist. Therefore, pathologic abnormalities of the scaphoid may have serious consequences⁽⁹⁾.

Under-treatment may result in significant complications, while overtreatment is associated with increased health-care costs and often results in lost workdays for the immobilized patient⁽¹⁰⁾.

However, 10% of conservatively treated scaphoid fractures evolve to pseudoarthrosis because the prevalently articular nature of this bone (80% of the scaphoid surface is covered by joint cartilage) leaves little space for vascular supply from the radial artery, which guarantees only 70–80% of nourishment of the surface⁽⁵⁾.

Treatment options include cast immobilization, closed reduction and percutaneous screw fixation or open reduction and internal fixation. In recent years, compression screws have been increasingly used for treatment of this injury as Interfragmentary compression and stable fixation is important to fracture union. Although the optimum force required to produce osseous union in vivo remains unknown, it is believed that greater interfragmentary compression promotes more predictable healing. Surgical fixation of the scaphoid is the accepted standard of care for the treatment of nonunions, delayed unions and displaced fractures⁽¹¹⁻¹³⁾.

These complications may eventually lead to osteoarthritis and collapse of the first carpal row, a state otherwise known as scaphoid non-union advanced collapse wrist (SNAC)⁽¹⁴⁾.

Aim of The work

The aim of this work is to assess the best appropriate distal screw entry zone in volar percutaneous headless compression screw fixation of acute scaphoid fracture to achieve the best screw (lay out or positioning) and proximal trajectory from co-axial and biomechanical point of view in addition to assessment of healing and functional outcome.

Patients and Methods

After obtaining human ethical committee approval with registration number of 30 patients with acute scaphoid fractures (Herbert type B1 & B2) were recruited for a randomized comparative prospective study. These patients were divided into 2 groups:

Group (1): (control group) : managed by volar percutaneous headless compression screw fixation with no pre-operative radiographic and CT planning.

Group (2): (study group) : Herbert types B1 and B2 were managed by volar percutaneous headless compression screw fixation after pre-operative radiographic and CT planning. All patients were operated at Hand & Microsurgery Unit [Orthopaedic Surgery Department, Minia University].

Objective: To determine the most appropriate point of entry of headless compression screw in percutaneous technique in types B1 & B2 to achieve the most appropriate screw insertion in relation to the fracture line and scaphoid anatomical axis.

Inclusion criteria:

- 1- Patients older than 18 years of age.
- 2- Acute injury (within 2 weeks of trauma).
- 3- Isolated unstable fracture of scaphoid waist (types B1 and B2 according to Herbert classification).

Exclusion Criteria:

- 1- Patients younger than 18 years of age.
- 2- Old scaphoid fractures.
- 3- Non compliant patients.
- 4- Associated other carpal injuries.
- 5- Scaphoid fractures other than types B1 and B2 according to Herbert classification.

Results

This study included 30 patients divided into 2 groups (study group=20, and control group=10), All patients were fractured by fall on outstretched hand mechanism of acute scaphoid waist fracture (oblique B1 and transverse B2). who were surgically managed by volar percutaneous headless compression Herbert screw [length (20 mm and 22 mm), and diameter (external diameter 3 mm, core 2.7 mm The average follow up period ranged 6-8months. The mean duration of surgery ranged 20-30 minutes.

Table 1: Postoperative data between the two groups

		Study group	Control group	P value
		N=20	N=10	
Union	<i>United</i>	19(95%)	8(80%)	0.251
	<i>Non-unioned</i>	1(5%)	2(20%)	
DASH	<i>Median</i>	0	5.8	0.062
	<i>IQR</i>	(0-6.2)	(0-14.4)	
Modified Mayo score	<i>Range</i>	(75-100)	(60-100)	0.006*
	<i>Mean ± SD</i>	94.8±7.3	84±12.6	
Modified Mayo score (grades)	<i>Poor</i>	0(0%)	1(10%)	0.041*
	<i>Fair</i>	1(5%)	1(10%)	
	<i>Good</i>	4(20%)	5(50%)	
	<i>Excellent</i>	15(75%)	3(30%)	
VAS	<i>Median</i>	0	0	0.439
	<i>IQR</i>	(0-0)	(0-1.3)	
Sum of small angles (SSA)	<i>Range</i>	(180-260)	(110-245)	0.005*
	<i>Mean ± SD</i>	227.8±25.7	192.5±36.2	

- Mann Whitney test for non-parametric quantitative data between the two groups
- Independent Samples T test for parametric quantitative data between the two groups
- Fisher's Exact test for qualitative data between the two groups
- *: Significant level at P value < 0.05

Discussion

The scaphoid bone is the most commonly fractured carpal bone, accounting for 50% to 80% of all carpal bone fractures and approximately 11% of all hand fractures. Mainly young, active individuals sustain scaphoid fractures. Approximately 80% of these fractures occur at the scaphoid waist. These fractures are usually considered stable and have a tendency to heal with conservative treatment. Immobilization in a thumb spica cast for 8 to 12 weeks is the most common treatment; however, this may be rejected by the young, active population desiring to participate in professional or sports-related activities or for social reasons.

Patients with scaphoid non-unions are likely to develop traumatic arthritis with increasing pain, decreased wrist mobility, and weakness.

Percutaneous fixation of scaphoid fractures with cannulated screws was first performed in 1962 in Germany by Von R. Strelt via a small volar incision. Slade et al., pioneered dorsal percutaneous fixation with a headless cannulated screw using mini fluoroscopy. Percutaneous techniques have resulted in faster recovery time and decreased duration of cast

immobilization in acute scaphoid fractures, compared with nonsurgical management. Percutaneous screws can be placed either by a volar or dorsal approach. The decision when choosing the approach is generally dependent on the fracture location and surgeon preference.

After obtaining human ethical committee approval with registration number of 30 patients with acute scaphoid fractures were recruited for a comparative prospective study. These patients were divided into 2 groups:

Group (1): control group: managed by volar percutaneous headless screw fixation with no pre-operative radiographic and CT planning.

Conclusion

The study shows that alpha angle is a novel tool to determine the best entry zone for percutaneous volar fixation of scaphoid waist fractures, with a low complication rates.

For transverse fracture a more lateral entry with central proximal trajectory is advised.

For short oblique fractures, a central entry point with centrolateral proximal trajectory is advised.

For long oblique fractures, a medial entry with lateral proximal trajectory is advised.

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