

Original Article

**VOLAR PERCUTANEOUS FIXATION BY HERBERT SCREW VERSUS
CONSERVATIVE TREATMENT FOR STABLE WAIST SCAPHOID
FRACTURE**

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Abstract

Background: scaphoid waist fractures can be fixed percutaneously as opposed to being cast-immobilized. Evaluation of the results of patients with stable waist scaphoid fractures following percutaneous fixation with a Herbert screw or cast immobilisation. **Methods:** A total of 30 patients, age from 19 to 60, were included in this prospective study at the orthopaedic department's hand and microsurgery unit at Sohag University Hospital. The extent of mobility, the strength of the grasp, the ability to return to work, and the radiological assessment were checked. **Results:** Follow up were 12 months. Patients who received volar percutaneous fixation experienced an earlier union than those who had conservative treatment with a cast. **Conclusion:** An earlier time to union, a rapid return to daily activities, and an earlier wrist motion recovery were all made possible by percutaneous treatment of acute stable waist scaphoid fractures. Compared to the operative group, the conservative group has a greater nonunion rate.

Keywords: Conservative, Volar, Percutaneous, Scaphoid fracture.

1. Introduction

Consecutive 30 patients with stable scaphoid waist fractures were treated. These fractures were randomly treated either fixed by a Herbert screw through volar percutaneous fixation or cast immobilisation. The most typical carpal bone to fracture is the scaphoid. It accounts for 2% of all fractures, 11% of hand fractures, and 60% of carpal fractures [1]. 29-43 fractures per 100,000 people are thought to occur annually as a result of scaphoid fractures [1]. Herbert's classification, which is based on fracture instability, is the most popular categorization scheme [2]. Good reduction and fracture site compression are necessary for early union. Good screw fixation will facilitate early revascularization, which promote fragment approximation, and permit early

wrist movement during the healing process. Active young males who work as manual workers are more likely to have a fracture. If immobilisation is achieved they are incapacitated. This surgical approach enables early wrist mobilisation and is suitable with multiple extremity fractures. Wozasek and Moser⁷ who employed a cannulated screw had 89% success rate. They reported percutaneous screw fixation. %, and Inoue and Tamura used a Herbert screw to treat ten patients with an undisplaced fracture and had a success rate of 100% [3]. If the scaphoid fracture is correctly immobilised, 95% of cases will heal. The degree of the fracture affects the average time for union [4].

2. Patients and methods

The Hand & Microsurgery Unit, Orthopedic dept., Sohag University Hospital conducted this prospective, randomized study from April 2020 to April 2021. Age above 19, acute, stable, non-displaced waist fracture measuring less than 2 millimeters (A2), closed fractures, and healing time of less than one month are the inclusion criteria. Exclusion criteria include bilateral fractures due to potential interference with postoperative grip strength measurements, as well as acute stable fractures of the tubercle (A1), acute unstable fractures of the proximal pole (B3), delayed union fractures (C), and established non-union fractures including fibrous (D1) and sclerotic (D2) fractures. Acute unstable distal third (oblique) (B1), acute unstable displacement of the waist (B2), and acute unsteady fracture dislocation (B4) (B5). likewise open cracks. If there was a prior ipsilateral injury, broken scaphoid bone. A terminal illness, signs of drug misuse, polytrauma, or were unable or unwilling to cooperate with follow-up. Patients were divided into two groups at random. Group 1 received percutaneous treatment within 14 days of the injury utilising a volar route and a Herbert screw, while Group 2 received cast therapy without the thumb. It took six weeks to be immobile. Regardless of the clinical or radiological results, no patient received treatment in a cast for more than 12 weeks. 40 patients between the ages of 19 and 60 participated in the study. The patients who were studied had an average age of 40.33 8.91 years and ranged from 28 to 53 years, with 24 men and 16 women, tab_s. (1-4). The average number of days since the injury was 16.54 + 8.36. Waist fracture A2 was stable in all patients

Table (1) Clinical characteristics among the studied patients

Variables	Patients (n=30)	
	Mean ± SD	Min – Max
Duration since injury (days)	16.54 ± 8.36	5 – 32

Table (2) Herbert classification among the studied patients

Variables	Studied Patients (n=30)	
	N	%
A2	30	100

Table (3) Statistics of the patient

	Patients (19 to 60)	Surgical (19 to 55)	Non-surgical (19 to 60)
Mean age			
Gender			
Male	25	13	12
Female	5	2	3
Employment			
Sedentary	10	6	4
Light manual	7	4	3
Moderate manual	6	1	5
Moderate manual	4	2	2
Heavy manual	3	2	1
Non employed			
Method of trauma			
Fall	10	4	6
A Height loss	4	2	2
Direct trauma	3	1	2
Sport	8	5	3
Motorcycle driver	3	2	1
Pedestrian	1	1	0
Other	1	1	0
Side of trauma			
Left	17	7	10
Right	13	8	5

Table (4) Functional outcome for the two categories

	Review (weeks)	Operative	Non- Operative
Mean weakness grip strength (%)	7	8	40
	10	2	20
	30	1	10
	45	2	4
Mean decrease range of movement (%)	7	10	50
	10	5	30
	30	3	10
	45	2	6

The medical research ethics committee at the faculty of medicine at Sohag Univ. will approve this project. Each patient will be asked to provide a written waiver of consent. There will be no charge for any inquiries. After the study is completed, the medical research ethics commission will approve it. Two possible courses of treatment for non-displaced fractures will be considered with the patient: cast immobilisation with a thumb Spica cast till union, or surgical surgery with screw fixation of the scaphoid using a percutaneous technique. Studying techniques: radiological assessment patients had preoperative post-eranterior, lateral, semi-pronated oblique radiographs; closed fist and ulnar deviation are best for scaphoid vision on the dorsopalmar projection. Tentative Timetable: The time frame for this investigation was between April 2020 and April 2021. Operational Method: Anesthetic: performed while supine and under tourniquet control, with either general anaesthesia or a brachial plexus block. all scenarios using a volitional approach, The patient was positioned supine on the operating table while under

general or local anaesthesia, and the volar scapho-trapezial joint was located, fig. (1).



Figure (1) Intra operative photo

Through hyperextension, the guide wire's insertion site at the scaphoid tubercle was reached via the trapezium. Under fluoroscopy, a guide wire was free-handedly inserted into the distal scaphoid along the central axis. Verify the position from various angles. The wire was passed through the fracture, to the proximal pole, and finally to the distant cortex. An incision of 5 mm was made in the skin around the guide wire insertion. A depth gauge or a wire of the same length was used to measure the variances in order to determine the length. To make sure that the screw will be completely buried in the distal cortex and won't impact on the proximal cortex, a screw that is 4 mm smaller than the actual measurement was chosen. After reaming around the proximal pole, the wire was further moved across it to prevent losing its position. Fourthly, a cannulated drill was advanced over the fracture site and stopped short of the distant cortex beneath after being entered around the wire. Free-hand insertion of a Herbert screw with a self-tap. The fracture site's compression was located. The screw's distal end was hidden beneath the surface. To make sure that the screw will be completely buried in the distal cortex and won't impact on the proximal cortex, a screw that is 4mm smaller than the actual measurement was chosen. After reaming around the proximal pole, the wire was further moved across it to prevent losing its position. Fourthly, a cannulated drill was advanced over the

fracture site and stopped short of the distant cortex beneath after being entered around the wire. Free-hand insertion of a Herbert screw with a self-tap. The fracture site's compression was located. The screw's distal end was hidden beneath the surface. Following surgery, a thumb-inclusive short-arm circular cast was put on. The cast will be taken off and activities will begin after three weeks. Analyzing the outcomes: clinical assessment using the Modified Mayo wrist score as a reference: Measurements of grip strength, range of motion, and job status are also included. Following a 2-week initial visit, radiographic evaluations will be performed every 4 weeks until the fracture has healed. At 18 months, there will be one last follow-up.

3. Results

In each group, 15 patients were randomly assigned. In any of the baseline traits, there were no significant differences between the groups, tab_s. (5-10).

Table (5) Average (interquartile range) Green/O'Brien scores were 31 with a good to excellent results.

Time (weeks)	Surgical	Non-surgical
8	79	39
Good/excellent	52	0
12	88	56
Good or excellent	68	15
26	92	78
Good or excellent	81	56
51	92	80
Good or excellent	100	88

Table (6) Times taken to full recovery

	Operative	Non-operative
Sports	(3 to 18)	(6 to 21)
Employment	(0 to 10)	(0 to 30)
Dressing	(0 to 2)	(0 to 10)

Table (7) Modified Mayo wrist score among the studied patients

Variables	Patients (n=15)
	Mean ± SD
Grip strength	13.75 ± 6.46
ROM	14.5 ± 7.76

Table (8) Satisfaction distribution among the studied patients

Variables	Studied Patients (n=15)	
	N	%
Very satisfied	8	53.3 %
Moderately satisfied	4	26.5%
No satisfied but working	2	13.3%
No satisfied, unable to work	1	6.6%

Table (9) Outcome distribution among the studied patients

	Patients (n=15)	
	N	%
Excellent	11	73.3%
Good	2	13.3%
Fair	1	6.6%
Poor	1	6.6%

Table (10) Modified mayo score for non-operative group

Variables	Patients (n=15)	
	N	%
Very satisfied	6	40
Moderately satisfied	4	26
No satisfied but working	3	20
No satisfied, unable to work	2	13.3

Mean grip strength and mean ROM for the operating group, according to the modified Mayo classification, were 13.75 6.46 and 14.5 7.76, respectively. Eight patients reported being extremely satisfied, four reported being moderately satisfied, two reported being dissatisfied but still able to work, and one patient reported being dissatisfied but unable to work. 5 (25%) of the patients were only good, while 13 (65%) were exceptional. Only one patient received fair care, and only one received bad care, figs. (2-4).



Figure (2) Male patient 30 years old with fracture waist screw fixation with volar percutaneous approach



Figure (3) Male patient 28 years old with waist scaphoid fracture

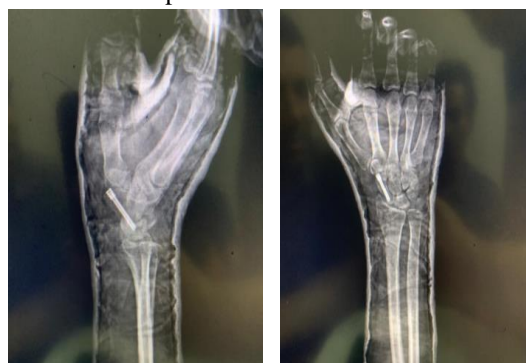


Figure (4) Post operative view (AP & LAT) with Herbert screw after volar approach and scaphoid cast

4. Discussion

A stable waist scaphoid fracture can be treated conservatively; after receiving sufficient cast care, union occurs in 90% of cases of none or minimally displaced (0.5 mm) scaphoid waist fractures after six weeks [5]. Although the functional effects of this extended immobilisation are not well understood, it can lead to considerable muscle atrophy and joint stiffness [6]. The basic course of treatment for acute waist scaphoid fractures, which are often stable and displaced by less than 2 mm, is cast immobilisation. This approach has issues, according to a lengthy study (Duppe et al., 1994) [7], and the claimed union rate is 88%. (Dias, 1989) surgery, whether it be open or percutaneous, In order to successfully implement Strelis' initial idea of percutaneous fixation of scaphoid fractures, it was necessary to develop an easier-to-use screw as well as superior fluoroscopic imaging. The headless cannulated screw created by Whipple from the headless compression screw

invented by Herbert [8] percutaneous Fixation is a common form of treatment for these patients, and high union rates have been documented. A percutaneous dorsal approach is best for proximal pole fractures, but a percutaneous volar approach damages the crucial articular cartilage of the proximal scaphoid pole; Patients who receive therapy with this method have a high probability of fracture union, avoid several hazards associated with cast treatment, with a percutaneous volar approach; Patients who receive treatment with this method avoid the protracted immobilisation of cast treatment, have a high rate of fracture union, and do not experience many of the hazards associated with open procedures [9]. Soft tissue injuries, such as those to tendons, cutaneous nerves, or the radial artery, as well as improper fixation screw placement [8]. Percutaneous screw fixation prevents scaphoid devascularization and carpal ligament division [10]. In the absence of the surgical methods of the past, the percutaneous approach utilised to fix a scaphoid fracture with a screw results in a minimizing of surgical exposure of the wrist, with the associated higher risk for infection and limitation of wrist movement. Regarding the study's patients' demographics, there were 25 males and 5 females, ranging in age from 19 to 60, and their mean BMI was 26.34 2.62 kg/m². 10 of the patients (33.3%) worked as sedentary labourers, 7 as light labourers (23.3%), and 6 as moderate labourers (20%). Four (13.3%) patients underwent strenuous labour, and three (10%) were unemployed. 13 patients were on the right side and 17 on the left. Study by Mohamed, et al. [11] which indicated that this study included 21 patients, confirmed our findings (15 males, 6 females and their ages range from 2 1years to 50 years with an average of 35.5). Additionally, Inoue & Shionoya [12] reported that the average age of the 3 females and 37 males was 27 years (18 to 62). 34 patients (85%) participated in manual labore. According

to the current study, 55% of patients experienced injuries on their right side whereas 45% had injuries on their left. The average number of days since the injury was 16.54 + 8.36. On the dominant side, 45% of the patients suffered fractures. Study by Gad, et al. [13] found that the dominant right-side prevalence was 88.9%, which is consistent with our findings. All of the cases were recent fractures lasting less than three weeks. Severo et al. [14], on the other hand, performed percutaneous treatment for 28 patients with a mean age of 30.5 years, a male prevalence of 89.2%, no prevalence of the dominant side, and a wrist fall as the primary aetiology (78.5%). Only patients with solitary scaphoid fractures and a longer period to presentation (4.16 weeks) were considered (range 1-8 weeks). According to the results of the current study, 60% of the patients were classified as Herbert B2s, 15% as Herbert B1s, 10% as Herbert B4s, and one patient as Herbert A2s. Our findings were consistent with those of El-Fadl & Salama's study [15], which revealed that four patients and eight patients, respectively, fit type B1 and type B2 of the Herbert classification. In the study we conducted, the mean pain among the patients was 16.54 6.31, the mean grip strength was 13.75 6.46, and the mean range of motion was 14.5 7.76, whereas Meermans & Verstreken [16] reported the assessments that were used to complete the modified Mayo wrist score at the final follow-up. Range of motion and grip strength statistics were equivalent to the side that wasn't damaged. Standard errors of the mean (SEM) for the average range of motion and grip strength were 1391 (SEM 5.1) and 57 kg (SEM 4.9) for the injured side and 1441 (SEM 4.9) and 52 kg (SEM 4.2) for the uninjured side, respectively. Range of motion and grip strength statistics were equivalent to the side that wasn't damaged. Standard errors of the mean (SEM) for the average range of motion and grip strength were 1391 (SEM 5.1) and 57 kg (SEM 4.9) for the injured side and 1441 (SEM 4.9) and 52 kg (SEM 4.2) for the uninjured side, respectively.

According to the Mayo wrist score used in the study by El-Fadl & Salama [15], ten patients received outstanding scores and two patients received good scores. The results of percutaneous fixation and immobilisation in a lengthy scaphoid cast were contrasted by Adolfsson et al. [17]. The fixation group had a considerably greater range of motion (ROM), but there were no differences in union rate or grip strength, according to the results. According to our findings, 55% of patients reported being extremely satisfied, 30% reported being moderately content, while only one patient reported being unsatisfied but unable to function. Regarding the outcome, 13 patients (or 65%) had outstanding results, whereas 5 patients (or 25%) had good results. Only one patient received fair care, and only one received bad care. Our findings corroborated those of Gad, et al. [13], who found that the current study attained very high levels of patient satisfaction and quality. The typical modified Mayo score following surgery was 90.29.0. (range 60-100). The majority (15 instances, 83.3%) had excellent ultimate results, followed by good (1 case, 5.6%), fair (1 case, 5.6%), and only one poor case, 5.6%. These findings are consistent with those of studies by Severo et al. [14] who showed that 92.80% of outcomes were excellent, 0% were good, 0% were fair, and 7.20 % were poor. Dráč, et al. [18] study compared immobilisation in a lengthy scaphoid cast with percutaneous fixation. Every fracture healed completely. The fixation group's time to unionisation and time to resume full duty both significantly decreased, according to the analysis. According to Haddad, et al. [19], union was achieved across the board at a mean time of 57 days, and patients were able to resume sedentary employment in four days and manual labour in five weeks. The Herbert screw and the Acutrak screw had similar compressive effects, according to Adla et al. [20]. Regardless of the screw type utilised for fixation, it is generally accepted that central screw placement influences fixation and compression at the fracture site. The headless Herbert screw,

which may be buried inside the scaphoid without upsetting its bone architecture, has biological advantages that cannulated screws do not have, according to Shaw [21] and Rankin, et al. [22], who also demonstrated that the cannulated screw had stronger compression forces. The surgical group went back to work on average six weeks sooner than the non-operative group. Up until the six-month evaluation, the Green/O'Brien score consistently revealed superior outcomes in patients who had undergone surgery. There is still a need for additional comparisons on the variations between the postoperative phases, such as the usage of plaster casts in the majority of research. Additionally, it's important to evaluate the financial costs of care and early rehabilitation for both patients who have conservative treatment and those who have percutaneous surgery. So we advise volar percutaneous fixation for stable waist scaphoid fractures for all patients who want quick healing, early return to everyday activity, rapid motion, and athletics.

5. Conclusion

An earlier time to union, a speedier return to daily activities, and an earlier wrist motion recovery were all made possible by percutaneous treatment of acute stable waist scaphoid fractures.

References

- [1] Duckworth, A., Jenkins, P., Aitken, S., et al. (2012). Scaphoid fracture epidemiology. *J. Trauma Acute Care Surg.* 72: E41-E45.
- [2] Ten Berg, P., Drijkoningen, T., Strackee, S., et al. (2016). Classifications of acute scaphoid fractures: A systematic literature review. *J. Wrist Surg.* 5: 152-159.
- [3] Inoue, G. & Tamura, Y. (1991). Closed technique for the Herbert screw insertion in an undisplaced fracture of the scaphoid. *J. Orthop Surg Tech.* 6: 1-7.
- [4] Russe, O. (1960). Fracture of the carpal navicular: Diagnosis, non-operative treatment, and operative treatment. *J. Bone Joint Surg [Am].* 42-A: 759-68.

- [5] Clementson, M., Jørgsholm, P., Besjakov, J., et al. (2015). Union of scaphoid waist fractures assessed by CT scan. *J. Wrist Surg.* 4: 49-55.
- [6] Skirven, T., Trope, J. (1994). Complications of immobilisation. *Hand Clin.* 10: 53-61.
- [7] Duppe, H., Johnell, O., Lundborg, G., et al. (1994). Longterm results of fracture of the scaphoid. *J. of Bone and Joint Surgery.*, 76A: 249-252.
- [8] Herbert, T. (1990). *The fractured scaphoid*. St. Louis, MO: Quality Medical Pub., USA.
- [9] Brutus, J., Baeten, Y., Chahidi, N., et al. (2002). Percutaneous Herbert screw fixation for fractures of the scaphoid: Review of 30 cases. *Chirurgie de la Main*, 21: 350-354.
- [10] Beek, M., Abolmaesumi, P., Luenam, S., et al. (2008). Validation of a new surgical procedure for percutaneous scaphoid fixation using intra-operative ultrasound. *Med. Image Anal.* 12 (2): 152-162.
- [11] Mohamed, H., Mohamed, E., Al-Sayed, M. (2019). et al. Volar Percutaneous fixation of recent fracture scaphoid. *The Medical J. of Cairo Univ.* 87: 2507-2514.
- [12] Inoue, G., Shionoya, K. (1997). Herbert screw fixation by limited access for acute fractures of the scaphoid. *The J. of Bone and Joint Surgery.* 79 (3): 418-421.
- [13] Gad, M., AL-sherbiny, E., Mahmoud, H., et al. (2020). Results of percutaneous fixation of acute scaphoid fractures by Herbert screw. *The Egyptian J. of Hospital Medicine.* 81 (2): 1419-1425.
- [14] Severo, A., Cattani, R., Schmid, F., et al. (2018). Percutaneous treatment for waist and proximal pole scaphoid fractures. *Revista Brasileira de Ortopedia.* 53 (3): 267-275.
- [15] El-Fadl, S., Salama, K. (2013). Percutaneous fixation of acute scaphoid fractures. *The Egyptian Orthopaedic J.* 48 (4): 385.
- [16] Meermans, G., Verstreken, F. (2008). Percutaneous transtrapezial fixation of acute scaphoid fractures. *J. of Hand Surgery (European).* 33 (6): 791-796.
- [17] Adolfsson, L., Lindau, T., Arner, M. (2001). Acutrak screw fixation versus cast immobilisation for undisplaced scaphoid waist fractures. *J. of Hand Surgery.* 26 (3): 192-195.
- [18] Dráč, P., Maňák, P., Labónek, I. (2005). Percutaneous osteosynthesis versus cast immobilisation for the treatment of minimally and non displaced scaphoid fractures. Functional outcomes after a follow-up of at least 12 month. *Biomedical Papers.* 149 (1): 149-151.
- [19] Haddad, F., Goddard, N. (1998). Acute percutaneous scaphoid fixation: A pilot study. *The J. of Bone and Joint Surgery.* 80 (1): 95-99.
- [20] Adla, D., Kitsis, C. & Miles, A. (2005). Compression forces generated by mini bone screws: A comparative study done on bone model. *Injury.* 36 (1): 65-70.
- [21] Shaw, J. (1987). A biomechanical comparison of scaphoid screws. *The J. of Hand Surgery.* 12 (3): 347-353.
- [22] Rankin, G, Kuschner, S., Orlando, C., (1991). A biomechanical evaluation of a cannulated compressive screw for use in fractures of the scaphoid. *The J. of Hand Surgery.* 16 (6): 1002-1010.