

Conservative Treatment Versus Percutaneous Fixation by Herbert Screw of Acute Non-Displaced Waist Scaphoid Fracture: A Randomized Controlled Clinical Trial

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ABSTRACT

Background: Social costs are reduced by using percutaneous fixation rather than cast immobilization for acute non-displaced fractures of the scaphoid's mid-waist. **Objective:** The purpose of this study was to evaluate the clinical and radiographic outcomes of Herbert screw versus non-operative treatment for acute, non-displaced waist scaphoid fractures. **Patients and methods:** A randomized controlled clinical trial was conducted on 18 adult patients with acute non-displaced waist scaphoid fractures attended at the Emergency Unit, Orthopedic Surgery Department, Zagazig University. Nine patients were treated conservatively with a scaphoid cast (Group 1), and the remaining nine were treated surgically with a Herbert screw (Group 2). **Results:** The mean union duration was 9.8 (SD 4.8) weeks and 7.9 (SD 3.3) weeks among group 1 and 2 respectively. The median was 10 and ranging from 8 to 16 weeks among group 1 and was 8 and ranging from 8 to 12 weeks among group 2. About 11.1% had non-union wrist in groups 1 and 2. Union duration did not differ significantly between both groups. The pain score was 18.9 (SD 7.9) among the participants, and the satisfaction score was 18.6 (SD 8.4) among the participants. The mean range of motion was 20.3 (SD 6.3) among the participants, and the mean grip strength was 17.2 (SD 5.5) among the participants. The mean total score was 75.6 (SD 23.5) among the participants and there were 16.7% had poor results, 11.1% had fair results, 38.9% had good results and 33.3% had excellent results. **Conclusion:** Cast immobilization is the standard of care for treating acute non-displaced scaphoid waist fractures however percutaneous fixation with a Herbert screw has some advantages.

Keywords: Non-Displaced Waist Scaphoid Fracture, Herbert Screw.

INTRODUCTION

The Scaphoid is a carpal bone that sits above the radius on the thumb side of the wrist. The bone serves a dual purpose, allowing for range of motion and providing stability at the wrist joint. The scaphoid bone has a boat like shape due to its length and curvature ⁽¹⁾.

About 50% to 80% of all carpal bone fractures occur at the Scaphoid in young, physically active people. The possibility of delayed union and nonunion makes the management of scaphoid fractures a contentious topic of discussion. Complications such as avascular necrosis, arthritis, and carpal collapse can be avoided with early diagnosis and treatment ⁽²⁾.

There are different types of treatment of scaphoid waist fracture, either conservative and screw fixation (open and percutaneous). Athletes and sports activities are not a good fit for conservative treatment, and the latter can postpone a patient's return to work. The use of percutaneous screws facilitates a speedier recovery and subsequent return to regular activities. Due to the scaphoid's boat-like shape, the surgeon must use finesse to guide a wire or fixation device along the scaphoid's true central axis, preventing the need for devascularization and preserving the integrity of the carpal ligaments ⁽³⁾.

Acute, undisplaced scaphoid waist fractures can be treated non-operatively, and screw fixation (open either percutaneous) has proven a suitable alternative for treating such fractures ⁽⁴⁾.

Patients with delayed union may need longer than the standard 8-12 weeks of immobilization. However,

severe joint stiffness and muscle wastage can occur as a result of this protracted immobilization, the functional effects of which are inadequately described. Multiple retrospective, non-randomized studies have found positive outcomes following open reduction and internal fixation of acute scaphoid fractures. There has been a marked reduction in postoperative complications following the surgical treatment of non-displaced fractures due to the development of more secure implants and less invasive surgical procedures ⁽⁵⁾.

For acute, non-displaced fractures of the scaphoid's mid-waist, percutaneous fixation has been shown to be more cost-effective than cast immobilization. When compared to other widely used procedures, open percutaneous fixation was also proven to be cost-effective when only direct expenses were considered ⁽⁶⁾.

The purpose of the current study was to evaluate the clinical and radiological outcomes of conservative versus percutaneous fixation of acute non-displaced waist scaphoid by Herbert screw.

PATIENTS AND METHODS

A randomized controlled clinical trial was conducted on 18 adult patients with acute non-displaced waist scaphoid fractures attended at the Emergency Unit, Orthopedic Surgery Department, Zagazig University.

Inclusion criteria: Aged from 18 to 6y ears with Scaphoid waist fracture for duration lower than 1

month, type of fracture: closed, as well as non-displaced ones with minimal displacement lower than 2 mm

Exclusion criteria: Cases with non-united, pole, comminuted or open fractures and whom duration was more than 1 month or displaced higher than 2 mm were excluded.

All of the participants who took part in this study went through:

1. Thorough medical history taking and an orthopedic examination.
2. All patients underwent radiological examination with anteroposterior (AP), lateral scaphoid (lateral), and oblique views.

Before surgery, all patients underwent a comprehensive battery of preoperative laboratory testing, including a full blood count, random blood sugar, viral screen, coagulation studies (PT/PTT), and kidney and liver function tests.

Treatment: Nine patients were treated conservatively with a scaphoid cast (Group 1), and the remaining nine were treated surgically with a Herbert screw (Group 2).

Conservative treatment: All 9 patients were treated with a scaphoid cast that included the thumb for three months, and while they did receive monthly checkups, the immobility did have some negative effects.

In group 2, acute, non-displaced waist scaphoid was fixed percutaneously with a Herbert screw:

The patient lay supine with the operated arm abducted at a ninety degree angle and supported with a radiolucent arm board. An inflatable tourniquet and general anesthesia were used. Maximum ulnar deviation was achieved by hyperextending the wrist and applying traction with the thumb (**Figure 1**).

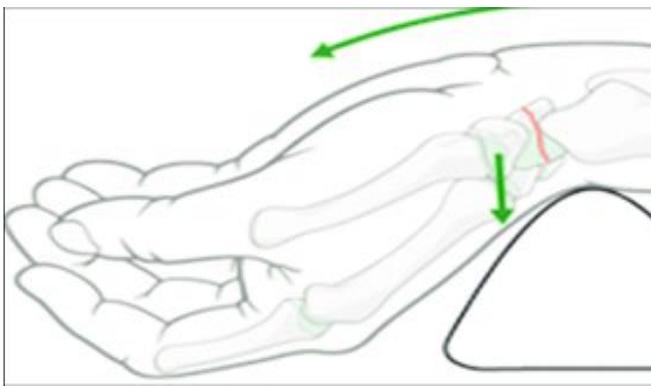


Figure (1): Hyperextension of the wrist joint to facilitate reduction.

Fluoroscopy was used to locate the scaphoid's central axis in the anteroposterior and lateral planes for precise screw placement using the percutaneous method. A guide wire was inserted under the skin along this axis.



Figure (2): Entry point for the guidewire.

The scaphoid tubercle was used as the attachment point for the guide wire, and the trapezium was brought dorsally using hyperextension. With ulnar deviation, the scaphoid slides away from the radial styloid process. The second step, performed under fluoroscopy and free hand, involved inserting a guide wire into the distal scaphoid along the bone's central axis. Verify its location using the AP and lateral views. Wire was routed over fracture, up the middle of proximal pole, and out to the distant cortex. After making a 5mm transverse incision around the guide wire entry, a blunt dissection was performed all the way to the scaphoid's distal pole. An accurate depth gauge was used to calculate the proper length of the guide wire. A guide was used to prevent damage to the delicate tissue while the drill was entered. A more biomechanically stable fixation is achieved with screws placed in the bone at the midline. The fracture location was drilled across with a cannulated drill and halted far into the cortex. The compression was verified by inserting a self-tapped Herbert screw.

Postoperative care: Cast was applied for approximately 2 weeks. Patients were advised to elevate the affected limb in the first several days after surgery to reduce edema. Postoperative edema was treated with nonsteroidal anti-inflammatory medications. At 2 weeks, patients returned for their initial post-op checkup. Hand grip exercises and active wrist flexion/extension were initiated, with the caveat that no weight lifting took place. Once that was finished, patients were seen at 4-week intervals. Radiographs were taken at each checkup to monitor the progress of the fracture. Follow-up time was adjusted according to radiographic fracture healing and clinical assessment. Using the Points System (The Mayo Modified Wrist Score).



Figure (3): Wrist motion after surgery: the final result. The side of the body that has surgery is the left. Extensive wrist extension (A). Flexion of full wrist (B). Complete hand grasp, with the wrist in a neutral position (C). Wrist fully prone (D). Wrist full supine (E).

Ethical Approval:

This study was ethically approved by the Institutional Review Board of the Faculty of Medicine, Zagazig University. Written informed consent was obtained from all participants. This study was executed according to the code of ethics of the World Medical Association (Declaration of Helsinki) for studies on humans.

Statistical Analysis

The collected data were introduced and statistically analyzed by utilizing the Statistical Package for Social Sciences (SPSS) version 20 for windows. The results were presented using graphical and tabular formats. Qualitative data were defined as numbers and percentages. Chi-Square test and Fisher's exact test were used for comparison between categorical variables as appropriate. Quantitative data

were tested for normality by Kolmogorov-Smirnov test. Normal distribution of variables was described as mean and standard deviation (SD), and independent sample t-test was used for comparison between groups. P value ≤ 0.05 was considered to be statistically significant.

RESULTS

The mean age among group 1 was 42.1 (SD 12.3) while the mean age among group 2 was 35.2 (SD 16.4). Age as well as gender did not differ significantly among groups. The median was 46 years among group 1 and 28 years among group 2. There were 55.6% males among group 1 and 66.7% males among group 2. There were 44.4% females among group 1 and 33.3% females among group 2 (**Figures 4 and 5**).

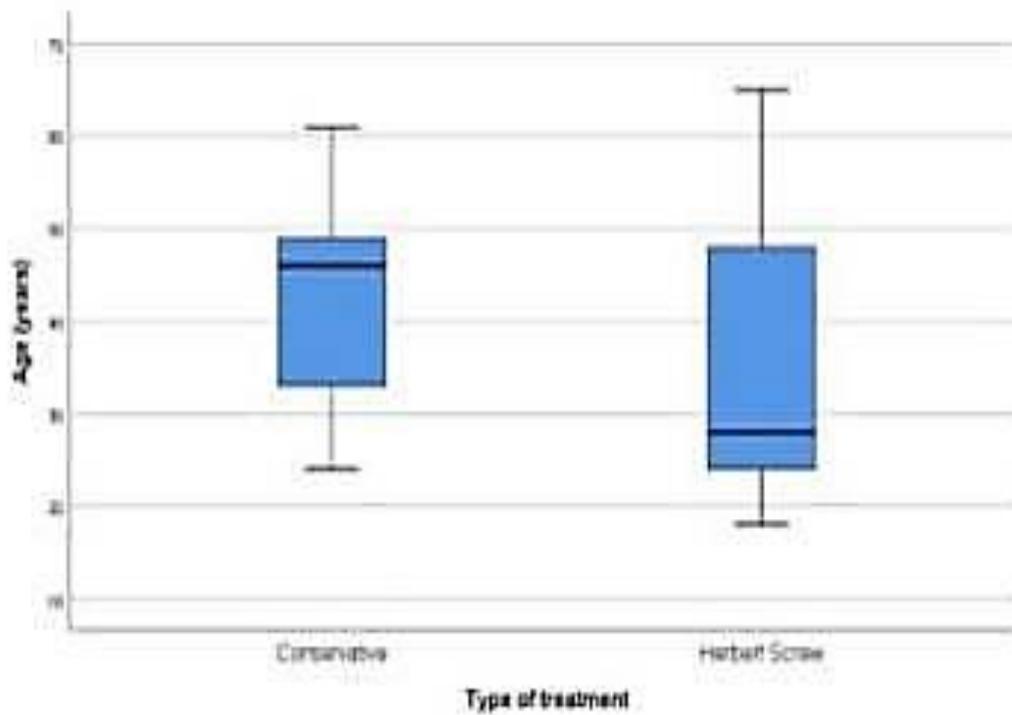


Figure (4): Age distribution among the two studied groups.

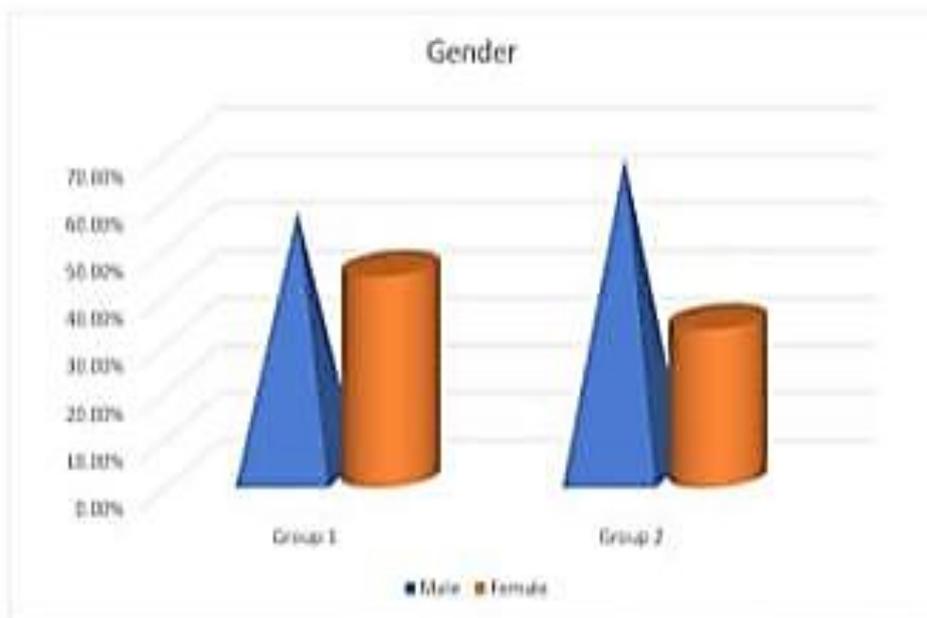


Figure (5): Comparing the two studied groups regarding gender.

Mean union duration did not differ significantly between the 2 studied groups (**Table 1**).

Table (1): Union duration among the two studied groups.

	Variable	Group 1	Group 2	P value
Union duration (weeks)	Mean ± SD	9.8 ± 4.8	7.9 ± 3.3	0.346
	Median (range)	10 (8-16)	8 (8-12)	
	Non-union	2 (22.2)	1 (11.1)	
	at 8 weeks	3 (33.3)	5 (55.6)	

Table 2 summarizes the results of the Mayo modified wrist score of all participants.

Table (2): The Mayo modified wrist score among all patients.

Variable		All patients
Pain	Mean ± SD	18.9 ± 7.9
Satisfaction	Mean ± SD	18.6 ± 8.4
Range of motion	Mean ± SD	20.3 ± 6.3
Grip strength	Mean ± SD	17.2 ± 5.5
Total score	Mean ± SD	75.6 ± 23.5
Final results	Poor, n (%)	3 (16.7)
	Fair, n (%)	2 (11.1)
	Good, n (%)	7 (38.9)
	Excellent, n (%)	6 (33.3)

Pain in group treated conservatively was less than in those who treated by Percutaneous Fixation by Herbert Screw with no significant difference between two groups. While satisfaction and grip strength was higher in patients treated by Percutaneous Fixation by Herbert Screw than who treated conservatively with no significant difference between two groups. Range of movement in both groups was found to be the same. Most of Patients (44.4%) treated by Percutaneous Fixation by Herbert Screw showed excellent results, while most Patients (44.4%) treated conservatively showed good results (**Table 3**)

Table (3): Comparison between the two studied groups regarding Mayo modified wrist score.

Variable		Group 1	Group 2	P value
Pain	Mean ± SD	17.2 ± 8.3	20.6 ± 7.7	0.391
Satisfaction	Mean ± SD	16.7 ± 8.7	20.6 ± 8.1	0.339
Range of motion	Mean ± SD	20 ± 7.5	20.6 ± 5.3	0.858
Grip strength	Mean ± SD	16.1 ± 5.5	18.3 ± 5.6	0.406
Total score	Mean ± SD	70 ± 27.3	81.1 ± 19	0.331
Final results	Poor, n (%)	2 (22.2)	1 (11.1)	0.767
	Fair, n (%)	1 (11.1)	1 (11.1)	
	Good, n (%)	4 (44.4)	3 (33.3)	
	Excellent, n (%)	2 (22.2)	4 (44.4)	

There were 66.7% and 88.9% had no complications among group 1 and 2, respectively. There were 11.1% had cast failure among group 1. There were 22.2% and 11.1% had non-union among group 1 and 2, respectively. Concerning complications, neither group differed significantly from the other. (**Table 4**).

Table (4): Comparing Complications among the two studied groups.

Variable	Group 1 (n. %)	Group 2 (n. %)	P value	
Complications	No	6 (66.7)	8 (88.9)	0.821
	Cast failure	1 (11.1)	0 (0)	
	Non-union	2 (22.2)	1 (11.1)	

Fisher Exact test; *P is significant at <0.05



Figure (6): A 45-year-old female, had a road traffic accident; suffering from pain, swelling at snuffbox at non-dominant left wrist. After requesting x-ray, show non-displaced, transverse fracture in the scaphoid bone. She treated conservatively by immobilization in scaphoid cast then, follow up by serial x-ray show complete union at 10 weeks. There are no any complications detected until the last vision, Diagnosis: non-displaced scaphoid fracture through the waist, Follow up period: 6 months. Type of treatment: Conservative Treatment. Union duration: 8 weeks. Complications: no complication detected in this case. Pain: 25. Satisfaction: 20 Range of motion: 25 Grip strength: 15. Final Mayo modified wrist score: 85 good.



Figure (7): 20 years male, fall on outstretched hand and injured his dominant right wrist. He had not any comorbidity (no DM and no hypertension). He suffered from pain and swelling at the bottom of your thumb. The pain can be very intense if he move wrist or thumb, or if he attempt to hold something. Wrist deformities, abrasions, and other injuries were looked for during the examination. X-rays showed that his scaphoid bone had a non-displaced transverse fracture. An intramedullary Herbert screw was placed 1 day after the injury. After 2 weeks of immobilization, the patient's fracture had healed. The functional outcome at the final follow-up was outstanding, with no wrist problems. Diagnosis: non-displaced scaphoid fracture through the waist .Type of treatment: Percutaneous Fixation by Herbert Screw. Union duration: 8 weeks. Complications: no complication detected in this case. Pain: 25. Satisfaction: 25 Range of motion: 25 Grip strength: 20. Final Mayo modified wrist score: 95 excellent.

DISCUSSION

About 50% to 80% of all carpal bone fractures occur at the scaphoid in young, physically active people. The possibility of delayed union and nonunion makes the management of scaphoid fractures a contentious topic of discussion. Avascular necrosis, arthritis, and carpal collapse can be avoided with a prompt diagnosis and treatment. When used to young people who are employed in physically demanding jobs, the difficulty increases because to the time off work necessitated by the immobilization (7).

Hospitals may have different policies and procedures in place for treating scaphoid fractures. In practice, however, managers must strike a balance between different types and levels of risk based on the facts at hand. Acute, non-displaced scaphoid waist fractures are typically treated non-operatively, and screw fixation (percutaneous or open) has gained acceptance as a therapeutic option for displaced fractures (8).

In recent years, the number of non-displaced scaphoid fractures that are surgically treated has grown thanks to the development of minimally invasive surgical procedures. When dealing with a non-displaced fracture, operating with percutaneous screw fixation can be beneficial since it allows for early functional treatment (9).

Complications can arise from both non-invasive and surgical treatments. Carpal instability, arthrosis, and collapse are among these conditions, along with delayed union, osteonecrosis, and pseudoarthrosis. Mobility and grip strength may be severely compromised as a result of these issues. Malalignment, improper screw placement, re-operation, infections, and soft tissue damage are additional risks associated with surgery (10).

In the present study, the mean age among group 1 (who treated by conservative treatment) was 42.1 while the mean age among group 2 (who treated by percutaneous fixation by Herbert screw) was 35.2. A comparison of the ages of the groups shows no statistically significant difference.

In agreement to our study, **McQueen et al.** (11) conservatively treated patients had a mean age of 30.5, whereas surgically treated patients had a mean age of 28.3, with no statistically significant difference between the two groups in terms of age and **Dias et al.** (12) indicated that there was no significant age difference between the groups.

In the current study, the majority of our patients in group 1 and 2 were males (55.6% versus 66.7%, respectively) with non-statistically significant difference between groups.

In agreement to our study, **McQueen et al.** (11) reported that the majority of patients in both groups were males with no statistically significant difference

between both groups as regard sex and **Dias et al.** (12) showed that no difference was detected between the groups with respect to sex.

In the present study, duration of union takes short time in patients treated by Percutaneous Fixation by Herbert Screw than in patients treated conservatively so more than half of patients (55.5%) treated by Percutaneous Fixation by Herbert Screw united within 8 weeks while in patients treated conservatively (44.4%) their union took more than 8 weeks. Union duration did not differ significantly among groups.

In agreement to our study, **Li et al.** (13) showed that the surgical group had a quicker time to union and a shorter recovery time than the nonsurgical group. In contrast to our study, **McQueen et al.** (11) found that Groups varied significantly in their time to union (Mann-Whitney U test, $P < 0.001$).

In the present study, according to Mayo modified wrist score among two studied groups, Pain in group treated conservatively was less than in those who treated by Percutaneous Fixation by Herbert Screw with no significant difference between two groups. Satisfaction and grip strength was higher in patients treated by Percutaneous Fixation by Herbert Screw than who treated conservatively with no significant difference between two groups. Range of movement in both groups was found to be the same with no significant difference between two groups.

In agreement to our study, **Li et al.** (13) revealed no statistically significant differences in patient satisfaction, pain, or DASH scores between surgical and nonsurgical therapies for scaphoid waist fractures with minimal or no displacement, **McQueen et al.** (11) found that Patients in the operating group did better early on in the review process when it came to regaining grip and pinch strength and ROM, but there was no significant difference between the groups at the final follow-up.

In the present study, most Patients (44.4%) treated by Percutaneous Fixation by Herbert Screw showed excellent results, while most Patients (44.4%) treated conservatively showed good results with no significant difference between two groups.

In agreement to our study, **McQueen et al.** (11) showed that patients who underwent surgery had much higher satisfaction ratings than those who did not. While, **Dias et al.** (12) showed that while our study found no significant difference between the two groups, another study found that patients whose injuries were treated surgically had a higher patient examination measure score at the eight-week follow-up evaluation, which coincided with the visit when their casts were removed.

In the current study, there were 66.7% and 88.9% had no complications among group 1 and 2 respectively. There were 11.1% had cast failure among group 1. There were 22.2% and 11.1% had

non-union among group 1 and 2 respectively. Concerning complications, neither group differed significantly from the other.

In agreement to our study, **Dias et al.** ⁽¹²⁾ found no significant difference in the incidence of medical complications between the two groups (four [2 percent] in the surgery group and five [2 percent] in the cast immobilization group), **Li et al.** ⁽¹³⁾ shown a decrease in the rate of nonunion in the surgical treatment group compared to the nonsurgical group and **Dias et al.** ⁽¹²⁾ found that 13 patients who had been handled surgically suffered problems. Consistent with our findings, the majority of problems were rather minor, and ten were directly related to the scar.

Limitations: Having such a small sample size is a weakness of this study. Percutaneous screw fixation of such fractures has the potential for a number of advantages, but there has to be more research done with a bigger sample size to discover the precise circumstances in which it should be used. The overall benefit of early repair of acute scaphoid fractures was also not established in this study. When recommending surgical therapy, it is also important to think about the dangers involved in the long run.

CONCLUSION

Percutaneous screw fixation is effective in treatment of scaphoid waist fracture and help to early return to work as our study confirms earlier time to union with percutaneous screw fixation of non-displaced fractures of the waist of the scaphoid.

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Competing interests: Nil.

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