

**Comparison of percutaneous screw fixation versus conservative treatment for fractures of the waist of scaphoid**

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**Abstract**

**Background:** Scaphoid waist fracture is a common type of wrist fracture, accounting for 51% to 90% of wrist fractures. The aim of present study was to evaluate the effectiveness of surgical compared with conservative treatments for fractures of the waist of scaphoid.

**Method:** A total 64 consecutive patients with fractures of the waist of scaphoid were randomly allocated to Percutaneous fixation with a cannulated Acutrak screw or immobilisation in a cast. The range of movement, grip and pinch strength, modified Green/O’Brien functional score, return to work and sports, and radiological evidence of union were evaluated at each follow-up visit. Patients were followed sequentially for one year.

**Results:** Patients in the operative group regained their grip and pinch strength as well as ROM more quickly in the earlier stages of review and consistently scored better on the modified Green/O’Brien score until one year. Patients in the operative group had a quicker return to sport (7.0 weeks) and full employment (4.2 weeks) as compared with those treated non-operatively (16.2 weeks and 12.3 weeks respectively), ( $p < 0.001$ ). Radiological outcomes shown, only resorption at eight weeks ( $p = 0.03$ ) and time to union ( $p < 0.001$ ) showed a significant difference between the groups. Patients undergoing

Percutaneous screw fixation showed a quicker time to union (9.35 weeks vs 14.2 weeks,  $p < 0.001$ ) than those treated with a cast.

**Conclusion:** With Percutaneous screw fixation, scaphoid waist fractures demonstrated a high rate of union and early return to work/sports. Therefore, we recommend that all active patients should be offered Percutaneous stabilisation for fractures of the waist of scaphoid.

**Keywords:** Scaphoid Waist Fracture; Percutaneous Fixation; Conservative Treatments; Stabilisation; Green/O’Brien Score; Grip and Pinch Strength

**Introduction**

Scaphoid fractures are most common in young male athletes between the ages of 15 and 25. The scaphoid is the most often fractured carpal bone, accounting for one-tenth of all hand fractures and two-thirds of all carpal fractures [1, 2]. In addition, scaphoid waist fractures account for two-thirds of all scaphoid fractures and are mostly non-displaced [3, 4].

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 [5]. Scaphoid waist fractures can be treated non-operatively, and screw fixation (open Percutaneous) has proven a suitable alternative for treating such fractures [6].

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 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 [7]. For 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 [8]. The aim of present study was to evaluate the effectiveness of surgical compared with conservative treatments for scaphoid waist fractures.

### **Materials and Methods**

A prospective randomised trial was performed on 64 patients between the ages of 18 to 65 years who presented with fractures of the waist of scaphoid. Patients had a previous ipsilateral fracture of the scaphoid, additional injuries to the ipsilateral upper extremity, a pathological condition of bone, a terminal disease, evidence of

substance abuse, polytrauma or were unwilling or unable to co-operate with follow up were excluded from the study. Patients were randomly divided into two groups of 32 patients in each group. Group 1 underwent percutaneous fixation of the scaphoid within 14 days of injury using a standard Acutrak screw whereas group 2 were treated in a Colles cast with the thumb free [9,10]. Immobilisation was continued for a minimum of eight weeks. If clinical or radiological examination suggested delayed union, a further cast was applied. No patient was treated in a cast for longer than 12 weeks, irrespective of the clinical or radiological findings.

Under tourniquet and with the patient supine, the upper limb was positioned on a hand table with the forearm supinated and the wrist extended over a roll. Reduction of the fracture was confirmed fluoroscopically. A guide wire was inserted percutaneously onto the tubercle of the scaphoid and the correct entry point confirmed Radiologically. The guide wire was introduced into the scaphoid using a power drill, taking care to place it centrally with its tip at the proximal pole. A satisfactory position was confirmed using anteroposterior (AP), lateral, pronated and supinated oblique views of the wrist. The tip of a second guide wire was placed at the entry point and the difference in length between the wires was measured.

Approximately 2 mm was subtracted from this value to obtain the desired screw length. The guide wire was then advanced into the radius to prevent it backing out with drill extraction. A 2 mm incision was made where the wire entered the skin. The scaphoid was drilled to the measured length under fluoroscopic control using a tapered cannulated Acutrak drill. A standard sized Acutrak screw was inserted, and its position confirmed fluoroscopically. One suture was placed in the wound. The wrist was not immobilised, and patients were

encouraged to mobilise within the limits of comfort. Physiotherapy was prescribed if clinically indicated. Clinical and radiological review was carried out at 8, 12, 26 and 52 weeks when tenderness at the fracture site and any complications were recorded.

Union was considered to have occurred when there was no tenderness at the fracture site and evidence of trabeculae crossing it on at least three views. Non-union was defined as absence of trabeculae crossing the fracture site with a persistent fracture gap and tenderness at 16 weeks [11, 12]. Malalignment was defined as the presence of a dorsal intercalated segment instability deformity. Resorption was defined as an increasing fracture gap.

A research physiotherapist in each centre, blinded to the treatment method by sticking plaster over the entry position, undertook functional testing at 8, 12, 26 and 52 weeks after fracture. This included range of movement (ROM), grip and pinch strength, time to return to work, sport, and normal activities of daily living (ADL), and a modified functional assessment [13]. Plasters were removed for radiological and functional testing and then reapplied.

The ROM was measured using a standard full circle goniometer. Flexion and extension were measured in triplicate and the mean was recorded to minimise intra observer bias. Each measurement was expressed as a percentage of the unaffected side.

The mass grip strength was measured using a JAMAR hand dynamometer (Therapeutic Equipment Corporation, Clyton, New Jersey). Functional assessment was measured using a modified Green/O'Brien score [14] which includes scores for pain, satisfaction, ROM and grip strength. These scores were added, with 90 to 100 points being excellent, 80 to 89 good, 65 to 79 fair and less than 65 poor. The time to return to work and sport

was recorded in weeks. All patients attended at eight weeks.

### Statistical Analysis

The groups were compared by chi squared or Mann Whitney U tests for categorised or quantitative factors respectively. Multiple ordinal logistic regression was used to test the effect of study group on time to return to work, adjusted for previous employment status. Intention-to-treat analyses were carried out using the 'last observation carried forward' method, in which missing outcomes at later times are replaced by those from the last time at which a valid observation was made.

### Results

A total of 64 patients were enrolled in the study and randomly divided into two groups of 32 patients in each group. Both the groups were comparable and found no significant differences with respect to demographic data of patients as shown in table 1.

Table 1: Demographics profile of the study population

Demographics data		Operative	Non-operative
Age in years	Mean	28.5±1.32	29.4±2.23
Gender	Male	25	27
	Female	07	05
Mode of injury	Fall	06	11
	Fall from height	05	05
	Direct blow	05	05
	Sport	10	09
	Motorcycle driver	05	02
	Other	01	00
Side of injury	Left	15	20
	Right	17	12

### Functional outcome

The patients in the operative group regained their grip and pinch strength as well as the ROM more quickly in the earlier stages of review, there was no significant difference between the groups at final follow-up as shown in table 2.

Table 2: The results of functional testing for the two groups at each review

Parameters	Review time (weeks)	Operative	Non-operative	p-value*
Mean decrease grip strength (%)	8	11 (-36 to 71)	43 (3 to 90)	< 0.001
	12	4 (-11 to 28)	27 (-1 to 86)	< 0.001
	26	-1 (-12 to 10)	12(-12 to 97)	< 0.001
	52	-2 (-11 to 13)	6 (-22 to 83)	0.33
Mean decrease pinch strength (%)	8	10 (-8 to 60)	31 (-13 to 85)	< 0.001
	12	6 (-22 to 41)	17 (-33 to 74)	0.018
	26	1 (-23 to 44)	3 (-32 to 86)	0.76
	52	-7 (-28 to 19)	2 (-28 to 83)	0.51
Mean decrease range of movement (%)	8	12 (-8 to 66)	54 (14 to 82)	< 0.001
	12	7 (-9 to 33)	33 (0 to 90)	< 0.001
	26	4 (-15 to 24)	12 (-5 to 76)	0.021
	52	3 (-14 to 26)	7 (-5 to 50)	0.34

\* Mann-Whitney U test

Table 3 show that patients in the operative group consistently scored better on the modified Green/O'Brien score until one year.

Table 3: Mean Green/O'Brien scores<sup>31</sup> and percentage good and excellent results

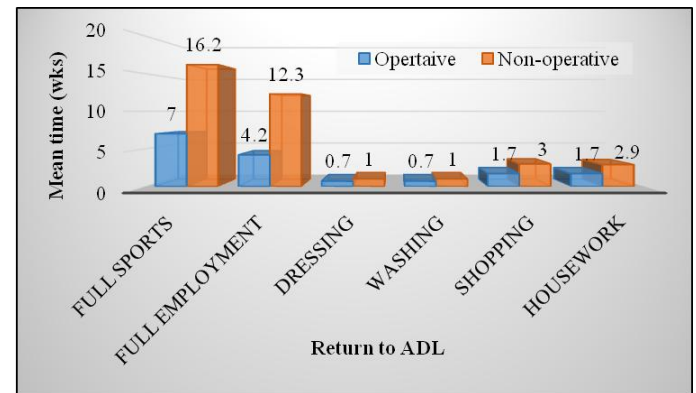
Review time (wks)	Operative	Non-operative	p-value*
8	81	42	<0.001
Good/excellent (%)	55	00	<0.001
12	90	57	<0.001
Good/excellent (%)	71	18	<0.001
26	95	80	0.007
Good/excellent (%)	83	60	0.058
52	97	85	0.46
Good/excellent (%)	100	89	0.031

\* Mann-Whitney U test

Patients in the operative group had a quicker return to sport (mean 7.0 weeks) and full employment (mean 4.2 weeks) compared with those treated non-operatively (mean 16.2 weeks and 12.3 weeks respectively) which was statistically significant (p<0.001) but showed no differences in other functional tasks as depicted in figure 1.

One patient in each group did not return to sports at one year, the patient in the cast group had not returned to work.

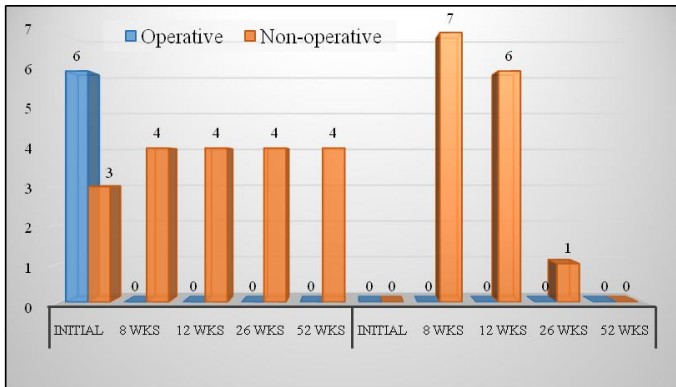
Figure 1: Mean times taken to return to normal activities of daily living (ADL).



### Radiological outcome

Figure 2 show the comparison of radiological outcomes in the two groups. Of the outcomes shown, only resorption at eight weeks (chi-squared test, p = 0.03) and time to union (Mann-Whitney U test, p <0.001) showed a significant difference between the groups. Although more patients in the operative group achieved union this was not quite significant (chi-squared test, p = 0.21). Non/delayed union reported in only 1 case of operative group and 3 case in non-operative group. The mean time to union in operative group was 9.35±4.3 weeks and in non-operative group it was 14.2±3.56 weeks.

Figure 2: Radiological outcome for the two groups at each review period



## Discussion

The present study revealed that the Percutaneous screw fixation has some advantages over cast immobilisation for the treatment of Herbert type B1 and B2 fractures of the waist of scaphoid. There was a trend towards fewer non-unions in the patients treated with fixation, but this did not reach statistical significance. The patients who were treated by operation had a more rapid return to sport and full work compared with those managed conservatively. Also, they had a more rapid return to function when measured objectively and using the Green/O'Brien score, which includes patient-rated outcome measures. Complication rates were low in both groups. These findings are comparable with the previous studies done by Bond et al [15], Dias et al [16], Adolfsson et al [17], Saedén et al [18] and McQueen MM et al [19]. All these studies showed more rapid return of function in terms of movement and grip strength in the operative group. However, two studies showed a significantly faster return to work in the surgical group [15, 18].

In the present study, early Percutaneous fixation accelerated union by almost five weeks compared with cast management, despite the fact that the mean time to union might have been expected to be prolonged in the surgical group which contained more displaced fractures. This finding could be criticised because of the absence of

blinding in the assessment of union. However, blinding is not possible in such a study because of the presence of the screw but this is mitigated by stringent criteria for the definition of union. The determination of time to union is limited by the frequency of follow-up and acquisition of radiographs. Ideally, these would have been taken weekly. However, because of practical limitations at each institute, it was decided that they would be taken only at designated follow-up visits. Dias et al found a significantly greater number of nonunions in their cast group [16] while Bond et al noted accelerated union similar to ours in their operative group [15]. The former study recruited the largest numbers of patients and used CT to diagnose non-union.

The use of Green/O'Brien score consistently found better results in operatively treated patients until after the six-month review. The only other study using a validated outcome score also found increased patient satisfaction but only at an early stage [16]. In terms of cost effectiveness, Davis et al [16] argue compellingly for the surgical treatment of nondisplaced fractures of the waist of the scaphoid. Their surgical model was open reduction and internal fixation. Presumably the cost of operative fixation would be even less in a Percutaneous model, assuming less time is spent in the operating room and with a lower rate of complications.

In terms of complications, in the operative group, there were three cases with peri-operative problems caused by breakage of the cannulated screwdriver. One patient had symptoms from a screw protruding into the scaphotrapezium joint and was awaiting admission for its removal at final review. There were no infections and no cases of a vascular necrosis (AVN). In the non-operative group two patients had radiological evidence of AVN. Two had persistent pain at 52 weeks. Two patients had malunion of the fracture with residual dorsal intercalated



segment instability deformity and one had symptomatic radioscapoid osteoarthritis at final review.

**Limitations:** A small sample size 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 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. Despite its limitations, present study confirms earlier time to union and quicker return to work and sport with Percutaneous screw fixation of fractures of waist of the scaphoid.

### Conclusion

Percutaneous screw fixation is effective in treatment of scaphoid waist fracture and help to early return to work and sport as present study confirms, also earlier time to union with Percutaneous screw fixation of fractures of the waist of the scaphoid. Hence, we recommend that all active patients with a fracture of the waist of the scaphoid should be offered Percutaneous internal fixation.

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