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**Dr. Tarigopula Sunil**  
Assistant Professor, Department  
of Orthopaedics, NRI Academy  
Sciences, Andhra Pradesh, India

**Dr. H Kalyan Kumar**  
Assistant Professor, Department  
of Orthopaedics, NRI Academy  
Sciences, Andhra Pradesh, India

**Dr. Sathya Kumar Koduru**  
Professor & HOD, Department  
of Orthopaedics, NRI Academy  
Sciences, Andhra Pradesh, India

## Percutaneous herbert screw fixation of undisplaced scaphoid fractures-evaluation of functional and radiological outcome

**Dr. Tarigopula Sunil, Dr. H Kalyan Kumar and Dr. Sathya Kumar  
Koduru**

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### Abstract

**Background:** On undisplaced scaphoid fractures treated with prolonged cast immobilisation may result in temporary joint stiffness and muscle weakness in addition to a delay in return to sports or work. Fixation of scaphoid fractures with a percutaneous screw has resulted in a shorter time to union and to return to work or sports. The purpose of this study was to evaluate the results of percutaneous screw fixation scaphoid fractures with respect to time to radiographic union and to return to work.

**Materials and Methods:** In 20 patients with fracture of the scaphoid, fixation with a percutaneous screw was done. Time to fracture union, wrist motion, grip strength and return to work as well as overall patient satisfaction at the time of a two-year follow-up were evaluated.

**Results:** Of the 20 patients in the study, mean radiological fracture union time was 12.2 weeks (range 8-15 weeks). Wrist function was excellent in 10 cases, good in remaining 6 cases and poor in 4 cases.

**Conclusion:** Percutaneous herbert screw fixation is a well-documented surgical procedure. Undisplaced scaphoid fractures fixed by percutaneous headless screw fixation yield better results than patients treated conservatively. Good range of motion is achieved after fixation. It relieves pain and functional disability experienced by patients. Percutaneous screw fixation of scaphoid fractures resulted in faster radiographic union and return to function. The specific indications for and the risks and benefits of percutaneous screw fixation of such fractures must be determined in larger randomised prospective studies.

**Keywords:** scaphoid fracture, percutaneous screw fixation, radiological out come

### Introduction

Scaphoid fractures are common injuries in emergency settings, accounting for 11% of all hand fractures and 60% of carpal fractures<sup>[1]</sup>. 80% of the scaphoid surface is covered by cartilage, and 70%-80% of its arterial supply is provided by branches of the radial artery, entering its dorsal crest in a predominantly retrograde flow<sup>[2]</sup>. Young men between the ages of 15 and 40 are the most affected; the incidence in individuals younger than 10 years is low. Hyperextension trauma with ulnar deviation is the most common mechanism of injury. Falls, automobile accidents, or sport related accidents are the main causes of this type of fracture<sup>[3]</sup>. Many minimally dislocated fractures are not visible on radiographs; these cases may present a risk of nonunion<sup>[4]</sup>. In the study by Wong and von Schroeder<sup>[5]</sup> in a series of 88 cases of patients diagnosed with scaphoid nonunion, 17% of cases did not present radiographs that were conclusive of fractures at admission, i.e., many cases are not diagnosed in the emergency room. The most common clinical sign of scaphoid nonunion is restricted wrist mobility. Furthermore, the presence of pain in the region of the anatomical snuffbox (aka radial fossa) and dorsum of the wrist (mainly during movement) and a decrease in strength can also be observed<sup>[3, 6]</sup>. The natural history of non-surgically treated scaphoid fractures presents an increase in the incidence of post-traumatic arthritis in 97% of patients five years after the trauma<sup>[7, 8]</sup>. Non-dislocated scaphoid waist fractures that are conservatively treated present a malunion incidence of around 5%-12%. 9, 10C

**Corresponding Author:**  
**Dr. Sathya Kumar Koduru**  
Professor & HOD, Department  
of Orthopaedics, NRI Academy  
Sciences, Andhra Pradesh, India

**AIMS and objectives**

1. To study the union rates of acute undisplaced scaphoid fractures fixed with Herbert screws.
2. To study the clinical outcome associated with this treatment modality.
  - Wrist range of movements.
  - Pain relief.
  - Return to normal activities of work and radiological union of fracture.

**Materials and methods**

This study that has been conducted in NRI General Hospital between January 2017 and January 2020 is concerned with evaluating the outcome of surgical management of functional and radiological outcome of undisplaced scaphoid fractures treated with HERBERT screw fixation.

**Inclusion Criteria**

1. Patients with undisplaced scaphoid fractures.
2. Patients willing to give consent and willing for follow-up.
3. Age criteria: 15 years to 65 years.

**Exclusion Criteria**

1. Patients with displaced scaphoid fractures.
2. Patients not willing for surgery.
3. Proximal pole fractures.

**Methods and analysis of the results**

A total of 20 patients diagnosed with undisplaced scaphoid fractures and operated upon with Herbert screws percutaneously in our hospital were included in the study. Post-operative X-ray and at Three, Six Weeks and three months after surgery as per patient's availability. Patients will be evaluated by modified clinical scoring system of Green and O'Brien.<sup>3</sup> and results will be analysed by percentage and proportions, test of proportions and statistical test (z-test) for proportions will be used for analysis.

**Observations and results**

Of the 20 patients that were followed up there were 6 females and 14 males. All patients were in the range of 24 yrs. and 55 yrs. with an average age at the time of surgery being 30 yrs. The patients who had an acute fall were diagnosed to have scaphoid fracture were treated immediately between 1-6 days. The majority of the patients were sports persons, manual labourers and also people who met with road traffic accident. All the 20 patient's wrist pain/tenderness in the anatomical snuff box/scaphoid tubercle tenderness/pain on axial compression of wrist or thumb/pain on movement of wrist/swelling over the wrist. All patients were treated by

percutaneous Herbert screw fixation either through volar or dorsal approach under guidance of image intensifier.

**Post-operative results**

Results in our study are evaluated by using Green and O'Brien Wrist Scoring System.<sup>3</sup>

Score	Findings
<b>Pain</b>	
25	None
20	Mild, occasional
15	Moderate, tolerable
0	Severe or intolerable
<b>Functional Status</b>	
25	Restricted to regular employment
20	Restricted to employment
15	Able to work, but unemployed
0	Unable to work due to pain
<b>Range of Motion</b>	
25	75-99% of normal
15	50-74% of normal
10	25-49% of normal
0	0-24% of normal
<b>Grip Strength</b>	(In degrees)
25	120 or more
15	91-119
10	61-90
5	31-60
0	30 or less
<b>Or Evaluating Dorsiflexion-Palmar Flexion of Injured Hand</b>	
25	100%
15	75-99% of normal
10	50-74% of normal
5	25-49% of normal
0	0-24% of normal
<b>Final Result</b>	
90-100	Excellent
80-89	Good
65-79	Fair
<65	Poor

The establishment of union was strictly derived from radiographic confirmation of continuous trabecular pattern and callus formation. Trabecular continuity was observed after 6 weeks in 7 patients, after 12 weeks in 5 patients and 2 Lost Follow Up.

**Table 1:** PF Distribution of Patients Studied

PF	%
≤50	10
51-70	45
>70	50
Total	100

2 patient had ≤50 degrees, 9 patients had 51-70 degrees and 10 patients had >70 degrees of palmar flexion.

**Table 2:** DF Distribution of Patients Studied

DF	%
≤50	5
51-70	15
>70	85
Total	100

1 patient had ≤50 degrees, 3 patients had 51-70 degrees and 16 patients had >70 degrees of dorsiflexion.

**Table 3:** RD Distribution of Patients Studied

RD	%
1-5	5
6-10	25
11-15	65
16-20	5
Total	100

1 patient had 1-5 degrees, 5 patients had 6-10 degrees, 13 patients had 11-15 and 1 patient had 16-20 degrees of radial deviation.

**Table 4:** UD Distribution of Patients Studied

UD	%
1-10	5
11-20	45
21-30	50
Total	100

1 patient had 1-10 degrees, 9 patients had 11-20 degrees and 10 patients had 21-30 degrees of ulnar deviation

**Table 5:** Radiological Trabecular Continuity at Follow-up

Radiological Trabecular Continuity at Follow-up	Percentage (%)
Not observed	5
6 weeks	40
7 weeks	20
8 weeks	35
Total	100

**Table 6:** Complications of Patients Studied

Complications	Percentage (%)
Radiocarpal Arthritis	15
Non-union of Scaphoid Fracture	5

4 patients had complications – 3 had radiocarpal arthritis and 1 had non-union of scaphoid fracture. Wrist pain had significantly decreased in all the patients.

**Table 7:** G & O W Score.<sup>3</sup> Distribution of Patients Studied

G & O W Score	Percentage (%)
≤80	20
81-90	30
91-100	50
Total	100

6 patients had good results and 10 patients had excellent results as per Green and O'Brien wrist scoring system. Return to daily activities - Manual workers (Manuals) had a longer time away from work than non-manual employees/individuals who were self-employed (Non-manuals) - median of 84 days and 16 days respectively.

## Discussion

In our study of 20 patients, the mean age of patients was found to be 30 yrs. This could possibly be because these fractures are more common in young and active age group, which is 2nd to 4th decades. Many other observations in this study are also comparable to the established facts described in the literature. This includes the overwhelming male preponderance associated with these fractures - which is 16 males: 4 females (F: M-4:1) and the fact that males are most predisposed to physical activities and accidents in India. Both groups showed good results.

In our study of 20 patients, 14 were right handed, while 06 were left handed with a ratio of 3:2. This is due to the fact that most of the patients are right hand dominant. Thus they would use right hand when they fall as a defence mechanism.

Of the 20 patients the mode injury pattern was - 9 had a history of fall on outstretched hand, 9 had history of a road traffic accident, 1 had a history of fall from 1st floor and 1 had a history of fall of an object on hand. Thus we can say that the main mechanism of injury is hyperextension /dorsiflexion of the wrist with a fall on the outstretched hand, when the individual straightens the arm for protection and the body weight and exterior forces are concentrated across the wrist.

In this position, the proximal pole of the scaphoid is securely held by the radius and the proximal radioscaphocapitate ligament, while the distal pole of the bone is carried dorsally by the trapeziocapitate complex. The radio scaphoid ligament is relaxed by the radial deviation and cannot alleviate the tensile stresses accumulating on the radio palmar aspect of the scaphoid. The fracture then propagates dorsally and can be transverse, oblique or comminuted depending on the direction of the applied loads.

In our study 16 patients did not have any associated injuries, 1 had radial styloid fractures, 1 had both bones forearm fracture, 1 had associated distal radius fractures and one patient had associated perilunate dislocation. It was due to the association with road traffic accidents. It signifies high velocity injuries. Fractures which are not associated with fractures showed better results after assessment by Green and O'Brien scoring system.<sup>3</sup>

Most of our patients were operated 1-6 days post injury. It signifies the amount of morbidity suffered by the patient. It is difficult to first diagnose a case of scaphoid fracture. If it is not apparent on initial X-rays, then we can take a CT scan or if the patient is not affordable we can repeat X-rays after 2 weeks when the fracture ends become sclerotic due to osteoclastic activity. Fractures fixed earlier had better results when assessed by Green and O'Brien scoring system, as physiotherapy was initiated earlier.

Our average period of follow-up of patients was 12.2 months. It is important to monitor AVN changes, Grip strength, Wrist range of motion and Pain relief during the follow-up. Regular physiotherapy needs to be followed for better results.

Average palmar flexion achieved by our patients was satisfactory and was 71.5 degrees. Average dorsiflexion achieved by our patients was 76.25 degrees. Our patients had followed regular physiotherapy exercises. Good dorsiflexion is important for good grip strength. In John T. Capo *et al.* study. 4 average palmar flexion was 710 and average dorsiflexion was 660. In Parajuli NP *et al.* study<sup>[9]</sup> mean palmar flexion was 610 and mean dorsiflexion was 600.

Average radial deviation in our patients was 13.75 degrees and average ulnar deviation was 22 degrees. Scaphoid moves with radial and ulnar deviation. So radial and ulnar deviation are important for the biomechanics of wrist.

Our patients evaluated by Green and O'Brien wrist scoring system had a mean of about 85.7, according to which the result is excellent; 4 patients had fair results, 6 patients had good results and 10 patients had excellent results as per Green and O'Brien wrist scoring system.<sup>3</sup> 10 patients had score between 91 and 100; 6 patients had score between 81 and 90 and 4 had score <80. This shows that this procedure had good results. Green and O'Brien scoring system.<sup>3</sup> is both a subjective and objective scoring system. Thus, it is a complete study.

Our study also showed that younger patients had better results. This is possibly due to the fact that younger patients have better pain tolerance and thus can follow post-op physiotherapy protocol better.

Average time of union was around 7 weeks as compared to conservatively treated group in literature was 12 weeks. Thus, we can conclude that percutaneous screw fixation removes factors which delay fracture union and it also promotes fracture healing by compression at fracture site. Manual workers (Manuals) had a longer time away from work than non-manual employees/individuals who were self-employed (Non-manuals)—median of 84 days and 16 days respectively. In our study 3 patients had developed radiocarpal arthritis, out of which one secondary to distal radius/radial styloid fracture. One patient had non-union of scaphoid. These are significantly less than that of conservatively treated patients in literature. Our study had 15% complication rate, while other studies like - Reis FB *et al.* [10], Drac P *et al.* [11], Duppe H *et al.* [12], Papaloizos MY *et al.* [13], Rettig AC *et al.* [14] and Smith JT *et al.* [15] had 27% complications rate.



**Fig 1:** Pre-operative X-ray



**Fig 2:** Post- Operative X-ray

### Conclusion

Percutaneous fixation of waist and proximal scaphoid fractures with a compression screw presents good results, being a good alternative to prolonged plaster cast use. Percutaneous fixation was shown to be a good way to treat these types of fractures; despite the steep learning curve, the method is reproducible and allows early active mobility of the wrist with a low rate of complications, earlier return to work,

and optimal functional results. This study suggests that percutaneous headless screw fixation for undisplaced scaphoid fractures provides satisfactory clinical and radiographic outcomes after an intermediate duration follow-up. Even though the procedure is not free of complications, the overall functional and clinical outcome had shown good results.



**Fig 3:** Clinical Assessment at Final Follow-up

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