

**ORIGINAL RESEARCH**

**Study of functional outcome of scaphoid fracture treated by open reduction internal fixation vs percutaneous fixation – A comparative study**

**Sanjay Manohar Patil<sup>1</sup>, Milind Nivrutti Kolhe<sup>2</sup>**

<sup>1</sup>Associate Professor, Department of Orthopedics, Dr. Ulhas Patil Medical College and Hospital, Jalgaon, India.

<sup>2</sup>Associate Professor, Department of Orthopedics, Dr. Ulhas Patil Medical College and Hospital, Jalgaon, India.

**ABSTRACT**

**Background:** Scaphoid fracture is the most common among carpal bone fractures, frequently imperceptible on initial radiographs. There is general consensus on the treatment of fractures of the proximal pole of the scaphoid and delays of consolidation and nonunion, entities are treated surgically. In present study, we aimed to compare functional outcome of scaphoid fracture treated by open reduction internal fixation vs percutaneous fixation.

**Material and Methods:** Present study was a prospective, observational & randomised study conducted in patients of age group 21-60 years, acute (<3 days), displaced scaphoid fracture (> 1 mm), willing to participate in study & follow up.

**Results:** 28 cases were divided into ORIF group (open reduction internal fixation) or PF (percutaneous fixation) group as 14 cases each. Mean age, gender, laterality & mode of trauma were comparable in both groups & difference was not significant statistically. After evaluation, patients were classified as per Herbert Classification. Distribution was comparable in both groups & difference was not significant statistically. In present study, Mayo wrist score was significantly better in PF group at 4, 8, 12 & 16 weeks as compared to groups & difference was significant statistically ( $p < 0.05$ ). While at 20 & 24 weeks, Mayo wrist score was comparable in both groups & difference was not significant statistically ( $p > 0.05$ ). At 24 weeks, Radiological outcome was grade 1 in 12 & 11 patients among ORIF group (open reduction internal fixation) & PF (percutaneous fixation) group respectively & difference was not significant statistically ( $p > 0.05$ ).

**Conclusion:** Percutaneous fixation of acute, displaced scaphoid fractures with percutaneous Herbert screws is an effective treatment which reduces the need of prolonged immobilization and helps in an early return to the routine activity as compared to open reduction & internal fixation.

**Keywords:** Percutaneous fixation, open reduction & internal fixation, scaphoid fractures, immobilization

**Corresponding Author:** Dr. Sanjay Manohar Patil, Associate Professor, Department of Orthopedics, Dr. Ulhas Patil Medical College and Hospital, Jalgaon, India.

**INTRODUCTION**

Scaphoid fracture is the most common among carpal bone fractures, frequently imperceptible on initial radiographs. Fracture of the scaphoid is a unique injury, delayed treatment or neglected fracture may lead to its non-union and may cause painful and severely disabled

wrist. The various treatment methods used for the treatment of displaced scaphoid fracture are closed reduction and cast, percutaneous fixation, or open reduction and internal fixation.<sup>1</sup> Tendency of scaphoid fracture to undergo in non-union makes it an important challenging injury for all orthopaedic surgeons. Displaced scaphoid fracture has high nonunion rate in conservative management asserting the need to explore operative treatment.<sup>2</sup> Stable, minimally displaced or incomplete fractures can be treated conservatively, and generally the consolidation rate is high. But this method requires prolonged immobilization, which can cause muscle atrophy, joint stiffness, disuse osteopenia, as well as sports and prolonged sick leave.<sup>3</sup>

Though the healing rate of nondisplaced waist scaphoid fractures with cast immobilization is 88% to 95%, provided that treatment is started within 3 weeks after injury, there is a trend towards early internal fixation in the recent times.<sup>4,5</sup> There is general consensus on the treatment of fractures of the proximal pole of the scaphoid and delays of consolidation and nonunion, entities are treated surgically.<sup>6,7</sup> In present study, we aimed to compare functional outcome of scaphoid fracture treated by open reduction internal fixation vs percutaneous fixation.

## **MATERIAL AND METHODS**

Present study was a prospective, observational & randomised study conducted in Department of Orthopedics, Dr. Ulhas Patil Medical College and Hospital, Jalgaon. Study duration was of 3 years, (from October 2018 to September 2021). Study was approved by institutional ethical committee.

### **Inclusion criteria**

- Patients of age group 21-60 years, acute (<3 days), displaced scaphoid fracture (> 1 mm), willing to participate in study & follow up.

### **Exclusion criteria**

- Patients with comorbid condition preventing surgical intervention,
- patients with delayed union or were treated by cast immobilization.
- Patients with distal radial tuberosity fracture,
- Patients with osteonecrosis, poor condition of local tissue
- Patients with previous wrist injury or any other associated fracture around the wrist

All the patients were subjected to clinical and radiological examination. Patients were subjected to X ray wrist postero-anterior view, lateral view, semipronation oblique and antero-posterior view to assess the scaphoid fracture. Injuries were graded according to Herbert and Fisher Classification.

After preoperative fitness, fit patients were randomly allocated to either ORIF group (open reduction internal fixation) or PF (percutaneous fixation) group. Operative procedure was explained to patients. All cases were performed by senior orthopaedic surgeon (> 10 years' experience), under either general anaesthesia or regional anaesthesia.

In PF group - percutaneous fixation was done using volar approach. In ORIF group, open reduction and internal fixation of displaced fractures were operated with Herbert headless screw. For scaphoid waist and distal pole fracture volar approach, and for proximal pole dorsal approach was used.

All patients were advised physiotherapy with hand grip strengthening exercise and active assisted range of motion exercise. Postoperatively patient was followed for 6 month at every 4week interval by the operating surgeon. At each follow-up patients were asked to fill the questionnaire of mayo wrist score and clinical examination necessary for completion of questionnaire was done, and the radiological outcome is measured in terms of union based on roentenographic grading system.

Data was entered in Microsoft excel sheet. The statistical analysis was done by un-paired t-test calculated by SPSS 21 version software. p value less than 0.05 was considered as statistically significant.

## RESULTS

During study period, 28 cases of acute displaced scaphoid fracture were underwent surgical correction & were divided into ORIF group (open reduction internal fixation) or PF (percutaneous fixation) group as 14 cases each. Mean age, gender, laterality & mode of trauma were comparable in both groups & difference was not significant statistically.

**Table 1: General characteristics**

Characteristic	ORIF group (n=14)	PF group (n=14)
Mean Age (years)	34.41 ± 6.82	32.53 ± 7.83
Gender		
Male	11 (78.57 %)	10 (71.43 %)
Female	3 (21.43%)	4 (28.57%)
Laterality		
Right	9 (64.29%)	8 (57.14%)
Left	5 (35.71%)	6 (42.86%)
Mode of injury		
RTA	8 (57.14 %)	9 (64.29%)
Other	6 (42.86%)	5 (35.71%)

After evaluation, patients were classified as per Herbert Classification. Distribution was comparable in both groups & difference was not significant statistically.

**Table 2: Distribution of subjects as per Herbert Classification**

Herbert Classification	ORIF group (n=14)	PF group (n=14)
A1	1 (7.14 %)	1 (7.14 %)
A2	1 (7.14 %)	1 (7.14 %)
B1	3 (21.43%)	3 (21.43%)
B2	5 (35.71 %)	5 (35.71 %)
B3	2 (14.29 %)	3 (21.43%)
B4	2(14.29 %)	1 (7.14 %)

In present study, Mayo wrist score was significantly better in PF group at 4, 8, 12 & 16 weeks as compared to groups & difference was significant statistically ( $p < 0.05$ ). While at 20 & 24 weeks, Mayo wrist score was comparable in both groups & difference was not significant statistically ( $p > 0.05$ ).

**Table 3: Mayo wrist score**

Mayo wrist score (Mean ± SD)	ORIF group (n=14)	PF group (n=14)	P value
4 week	47.30 ± 7.07	55.63 ± 11.75	0.045
8 week	62.18 ± 11.02	69.98 ± 10.84	0.039
12 week	80.20 ± 12.92	89.81 ± 14.53	0.026
16 week	91.47 ± 11.54	96.36 ± 13.11	0.028
20 week	94.77 ± 10.73	97.81 ± 11.92	0.072
20 week	96.37 ± 11.42	97.91 ± 10.01	0.73

At 24 weeks, Radiological outcome was grade 1 in 12 & 11 patients among ORIF group (open reduction internal fixation) & PF (percutaneous fixation) group respectively & difference was not significant statistically ( $p > 0.05$ ).

**Table 4: Radiological outcome at 24 week.**

Outcome	ORIF group (n=14)	PF group (n=14)
Grade 1- Normal appearance and union. No osteopenia & fracture line (excellent result)	12 (85.71 %)	11 (78.57 %)
Grade 2 - Union with osteopenia (good result)	1 (7.14 %)	1 (7.14 %)
Grade 3- Non-union but a good clear outline of the Scaphoid. No evidence of necrosis (fair result)	1 (7.14 %)	1 (7.14 %)
Grade 4- Non-union and a poor outline, With evidence of necrosis. (poor result)	0	1 (7.14 %)

## DISCUSSION

The importance of fracture of carpal scaphoid lies in the fact that the bone most commonly injured carpal is difficult to diagnose in many cases, and requires immobilization for long periods due in part to its peculiar vascularization.<sup>8</sup> Cast treatment has the disadvantages of longer immobilisation time, joint stiffness, reduced grip strength, and longer time to return to work whereas the operative fixation of acute scaphoid fractures results in predictable satisfactory union rate and good functional outcome.<sup>9</sup>

Mittal V et al.,<sup>10</sup> studied 20 scaphoid fractures treated by either ways, were united successfully with no complications. All Eight (100%) patients had excellent results with percutaneous fixation. Five (41.67%) patients had excellent results with Six (50%) patients had good results and one (8.33%) patient had fair result with ORIF. Radiological union was confirmed postoperatively in all patients treated with percutaneous fixation at 8.8 week (range 7-12 week) and ORIF 12.1 week (range 8-16 week) respectively.

Both close reduction and percutaneous fixation or open reduction and internal fixation are options to reliably diminish the incidence of nonunion and malunion that occur with cast immobilization in scaphoid fracture. But percutaneous fixation leads to early union and early return to functional activity and lesser complications as compared to open reduction and internal fixation.<sup>10</sup>

In study by Dinkar KS et al.,<sup>11</sup> radiological union in cases treated with percutaneous fixation was faster as compared to cases treated by ORIF. Also patients treated with percutaneous method demonstrated higher mean range of motion score, mean grip strength score and activity score. Excellent results have been obtained in cases treated with percutaneous approach in terms of post-operative morbidity and this approach also allows earlier return to sports and work.

Haddad and Goddard reported union rates approaching 100%, excellent functional results, rare complications and return to manual labour within five weeks after percutaneous fixation and immediate post-operative mobilisation.<sup>12</sup> In a prospective randomised trial of 25 full-time military personnel with acute nondisplaced fractures of the waist of the scaphoid, faster radiological union and return to military duty was reported after percutaneous cannulated screw fixation compared with cast immobilization.<sup>13</sup>

Percutaneous screw fixation is a simple technique and fracture reduction and fixation can be accomplished without further injury to the scaphoid blood supply and stabilizing ligament of the wrist. An objective measurement of fracture gap by CT scan at six weeks is useful in predicting cases with tendency for delayed union.

Percutaneous fixation of scaphoid fractures through dorsal approach gives good clinical and functional outcome in acute and chronic scaphoid fractures of B1, B2 and C types (Herbert's classification).

Potential points of entry for fixation devices are limited by approximately 80% of the surface of the scaphoid bone being covered with articular cartilage. An additional constraint is the boat shape of the scaphoid, requiring special skills on the part of the surgeon to maneuver a wire or a fixation device along the true central axis of the scaphoid.<sup>15</sup>

## CONCLUSION

Percutaneous fixation of acute, displaced scaphoid fractures with percutaneous Herbert screws is an effective treatment which reduces the need of prolonged immobilization and helps in an early return to the routine activity as compared to open reduction & internal fixation.

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