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Original Research Article

Comparison between functional outcome of scaphoid fracture treated by open reduction internal fixation vs percutaneous fixation

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ABSTRACT

Introduction: Scaphoid bone fracture is one of the commonest carpal bone fractures. It is predominantly seen in young population. Unstable or displaced scaphoid fractures can be treated either by primary use of cast immobilization alone, by use of Open Reduction Internal Fixation (ORIF) technique or by percutaneous fixation with Herbert screw under direct C arm fluoroscopic guidance. This study aims to review clinical, radiological and function outcome following ORIF technique Vs Percutaneous Fixation Technique in scaphoid fractures.

Materials and Methods: Cases of acute scaphoid fractures who came to our department and met inclusion and exclusion criterias were identified and included in this study. Clinical details of these patients were obtained and scaphoid radiographs were taken. Injuries were graded as per Herbert and Fisher Classification. All our cases underwent grip-strengthening exercises and relevant physiotherapy. Clinico-radiological details of our cases were obtained at each follow-up. Final follow-up of our cases was performed using Modified Mayo Wrist Score (MMWS). Grip strength was graded as per Medical Research Council (MRC) scale and range of motion was assessed using goniometer.

Results: A total of 40 cases were enrolled in our study. 16 patients (40% cases) underwent percutaneous herbert screw fixation and rest of our cases underwent open reduction and internal fixation. 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.

Conclusion: In our study 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 thereby necessitating importance of this approach over ORIF approach in a developing resource poor country like India.

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1. Introduction

The term ‘scaphoid’ is derived from the Greek word “skaphos” meaning boat, which refers to the resemblance of shape of the bone to a boat.¹ Scaphoid bone fracture is one of the commonest carpal bone fractures. It is predominantly

seen in young population.

Displaced, comminuted, and unstable fractures of the scaphoid are routinely managed with surgical intervention with either Open Reduction Internal Fixation (ORIF) technique or arthroscopically assisted percutaneous fixation technique.

The treatment of undisplaced or minimally displaced acute scaphoid fractures is controversial. As per current

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opinion, patients with undisplaced scaphoid fractures need cast immobilization for at least 6 to 12 weeks ultimately leading to considerable loss of time and productivity in a predominantly young and active population.^{2–6} Advocates for early operative intervention claim that screw fixation not only limits the need for a cast, but may also allow earlier return to sports and work.^{7–10} For these fractures, percutaneous fixation technique is superior to ORIF technique in terms of providing superior union rates, faster functional recovery, and reduced surgical morbidities like scar and complex regional pain syndrome (CRPS).^{11–13} 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.^{14–19}

Nonunion occurs in approximately 10% of all scaphoid waist fractures. Displaced fractures have a 50% nonunion rate, with an increased rate also seen with proximal pole fractures.^{20–24} Nonunion rate is much lower for undisplaced fractures and approaches to zero when an undisplaced fracture is adequately treated and protected.^{25,26}

Our study aims to review clinical, radiological and functional outcome following ORIF technique Vs Percutaneous Fixation Technique in scaphoid fractures.

2. Materials and Methods

This prospective study was conducted after getting approval from our ethical committee and the study duration was forty-eight months (November, 2015 to November, 2019). During this study duration, a total of 44 cases of scaphoid fracture were treated with Herbert screw at our department which included cases of acute scaphoid fracture, cases of scaphoid fracture with delayed union, fractures which showed no signs of healing after 12 weeks wearing plaster cast and cases presenting with scaphoid fractures four weeks to three months after injury. Our exclusion criteria included cases who had tuberosity fracture/trans-scaphoid perilunate dislocation/Dorsal intercalated segmental instability deformity (DISI)/osteonecrosis of proximal scaphoid fragment and cases who had history of previous wrist injury or any other associated fracture around the wrist.

Out of 44 cases, 40 cases met our inclusion criteria and were included in our study. All our cases underwent scaphoid radiographs using standard [posteroanterior(PA) /lateral] views and special [semipronation oblique and anteroposterior(AP) view with wrist in ulnar deviation] views. Injuries were graded according to Herbert and Fisher Classification.

All fractures were first tried for percutaneous fixation using volar approach. In cases where adequate reduction was not achieved, ORIF(volar approach) technique was performed. The only exclusion to this were cases who presented 151 days after injury and these cases were treated

directly with ORIF and bone grafting. For ORIF as well as percutaneous fixation technique volar approach was used.

In all our cases scaphoid cast was applied post operatively. Sutures were removed two weeks after the operation and cast immobilization was continued for another four weeks. After six weeks, cast was removed and replaced with removable wrist immobilizer brace for another four weeks. All our patients underwent physiotherapy in form of hand grip strengthening exercises with active assisted range of motion exercise of wrist. All patients were evaluated at two weekly intervals until fracture union was evident. At each follow up, patients were subjected to clinical as well as radiological examination with scaphoid profile. Union was considered to have occurred when there was no tenderness at the anatomical snuff box or at the scaphoid tubercle and there was evidence of trabeculae crossing fracture on at least two views. On final follow up clinical assessment were performed based on Modified Mayo Wrist Score (MMWS). The minimum follow up duration was twelve months.

Grip strength was measured asking the patient to squeeze the examiners index finger, and the strength was compared to contralateral side. Grip strength was graded according to Medical Research Council (MRC) grading. Range of motion was measured using goniometer.

3. Results

The mean duration of presentation after injury was 17.6 days (range 1-151 days). Sixteen (40%) patients were operated within first week after injury, fourteen (35%) patients between first and second weeks and six (15%) patients were operated between second to fourth weeks. Four (10%) patients had delayed union of scaphoid waist fracture after 6 weeks of cast treatment.

All 40 scaphoid fractures treated by either ways united successfully. Radiological union was confirmed postoperatively in all patients treated with percutaneous fixation at 8.75 week (range 6 – 12 weeks) and by ORIF at 11.91 week (range 7– 16 weeks) respectively.

In patients with delayed union with cast treatment, fracture union was seen at 12.6 weeks (range 10-15 weeks) post operatively. In cases treated with percutaneous fixation wrist flexion averaged 62° (range 40 to 75°) and wrist extension averaged 63° (range 40 to 70°) whereas in ORIF treated cases wrist flexion averaged 59° (range 30 to 70°) and wrist extension averaged 57° (range 30 to 65°).

According to Modified Mayo wrist score (MMWS), the mean pain score was 21.0 (range 10 to 25) with percutaneous technique and 20.4 (range 10 to 25) with ORIF technique; mean range of motion score being 23.8 (range 15 to 25) with percutaneous technique and 22.2 (range 15 to 25) with ORIF ; mean grip strength score was 23.4 (range 15 to 25) with percutaneous technique and 22.7 (range 15 to 25) with ORIF and activity score was 21.5 (range 15 to 25)

Table 1: Demographic profiles of patients and details of approach, MMWS and complication

S. No.	Age	Sex	Side	Herbert type	Time to surgery (days)	Approach	Time to union (week)	Mmws (points)	Remark
1	20	M	R	B2	5	ORIF Volar	12	90	
2	41	M	L	B2	17	Percutaneous Volar	8	100	
3	44	M	R	C	151	ORIF Volar	14	80	Bone grafting was done
4	29	M	R	C	44	ORIF Volar	11	75	Cast Failure
5	24	F	L	A2	20	Percutaneous Volar	9	95	
6	26	F	L	B2	3	ORIF Volar	7	95	
7	21	F	R	A2	14	ORIF Volar	9	90	
8	24	F	L	A2	4	Percutaneous Volar	6	90	
9	28	F	R	B2	2	ORIF Volar	10	85	
10	29	M	R	B2	8	Percutaneous Volar	12	95	
11	20	M	L	A2	10	ORIF Volar	16	85	
12	39	M	L	B2	8	ORIF Volar	14	80	
13	33	M	R	A2	4	Percutaneous Volar	10	95	
14	26	F	L	A2	1	Percutaneous Volar	8	100	
15	22	M	R	B2	12	ORIF Volar	12	90	
16	30	F	R	A2	5	Percutaneous Volar	8	95	
17	28	M	L	A2	16	ORIF Volar	14	85	
18	25	M	R	B2	5	ORIF Volar	10	90	
19	40	M	L	A2	8	Percutaneous Volar	9	90	
20	18	F	L	B2	7	ORIF Volar	14	85	
21	29*	F	R	B2	5	ORIF Volar	12	90	
22	28	M	L	B2	17	Percutaneous Volar	8	100	
23	24	M	R	C	149	ORIF Volar	14	80	Bone Grafting Was Done
24	21	M	R	C	44	ORIF Volar	11	75	Cast Failure
25	19	F	L	A2	20	Percutaneous Volar	9	95	
26	24	M	L	B2	3	ORIF Volar	7	95	
27	29	F	R	A2	14	ORIF Volar	9	90	
28	25	M	L	A2	4	Percutaneous Volar	6	90	
29	41	M	R	B2	2	ORIF Volar	10	85	
30	20	M	R	B2	8	Percutaneous Volar	12	95	
31	20	M	L	A2	10	ORIF Volar	16	85	
32	39	F	L	B2	8	ORIF Volar	14	80	
33	33	F	R	A2	4	Percutaneous Volar	10	95	
34	19	F	L	A2	1	Percutaneous Volar	8	100	
35	22	F	R	B2	12	ORIF Volar	12	90	
36	30	F	R	A2	5	Percutaneous Volar	8	95	
37	28	M	L	A2	16	ORIF Volar	14	85	
38	44	M	R	B2	5	ORIF Volar	10	90	
39	40	M	L	A2	8	Percutaneous Volar	9	90	
40	18	M	L	B2	7	ORIF Volar	14	85	



Fig. 1: Shows an 151 days old fracture in 44 years male, who was treated with open reduction and Herbert screw fixation with bone grafting. 14 week post operative radiographs showed complete union with excellent results



Fig. 2: Shows an 151 days old fracture in 44 years male, who was treated with open reduction and Herbert screw fixation with bone grafting. 14 week post operative radiographs showed complete union with excellent results

with percutaneous technique and 20.1 (range 15 to 25) with ORIF. The mean MMWS score was 95 (range 90 to 100) for percutaneous technique and 85.4 (range 75 to 95) for ORIF. Accordingly 16 (100%) patients had excellent results with percutaneous fixation whereas 10 (41.67%), 12 (50%) and 2 (8.33%) patient had excellent, good and fair results respectively with ORIF.

There were no perioperative complications. None of the our subjects had malunion. None of the patients showed signs of post traumatic osteoarthritis of the scaphoid or that of wrist at final follow up.

4. Discussion

Our findings are consistent with that of McLaughlin et al who recommended use of ORIF technique in treatment of acute scaphoid fractures using a compression lag screw to allow early mobilization of wrist.^{27,28} In a study by Rettig ME et al; out of 14 patients with acute displaced scaphoid waist fractures treated by open reduction and internal fixation with Herbert screw and K wires using either volar approach or dorsal approach, thirteen (93%) out of 14 cases achieved fracture union within 11.5 weeks (range 8 – 20 weeks) with good function.¹⁰ In our study all fracture cases treated by percutaneous fixation achieved union within 8.75 weeks (range 6 to 12 week) and fracture cases treated by ORIF achieved union within 11.91 weeks

(range 7 to 16 week).

As seen in studies conducted by Aguilera et al and Albertsen et al, percutaneous Herbert screw fixation lead to fracture reduction and fixation without further injury to the scaphoid blood supply and stabilizing ligament of the wrist.^{18,19} This statement was confirmed in our study in form of earlier radiological healing and less union time taken by fractures treated by percutaneous method. As compared to Shin AY et al found that the fracture union occurred at an average of 7.1 week compared to 11.6 weeks with cast treatment using volar percutaneous fixation for stable scaphoid fracture²⁹ our study has average union time of 9 weeks for undisplaced fractures. Naranje S et al reported 100% union rate with percutaneous Herbert screw fixation by dorsal approach in 32 patients involving both acute and chronic scaphoid fracture presentations;³⁰ we obtained similar result in our study with percutaneous Herbert screw fixation by volar approach. Also less pain, increased range of motion and grip strength was found in patients treated with percutaneous fixation as compared to ORIF. Although union rate approached to 100% in cases treated by either method but union rate and time to return to activity, subsidation of pain, grip strength and movements were better in cases treated with percutaneous fixation than ORIF.

The major limitation of our study is the small sample size and heterogenous group of patients within the study ranging

from acute to chronic presentations to post cast failure presentations leading to altered results due to residual stiffness of wrist due to prolonged wrist immobilization. Further in our study none of the patients had proximal pole fracture which may bias the result.

5. Conclusion

Scaphoid fractures can be treated by a number of surgical methods. Percutaneous screw fixation by Herbert screw and ORIF technique have emerged as two one of the best techniques for treatment of these fractures. Both close reduction and percutaneous fixation or open reduction and internal fixation are reliable options to decrease the incidence of nonunion/malunion with residual carpal instability in patients which arise secondary to cast immobilization in treatment of scaphoid fractures; however percutaneous fixation technique leads to early union and early return to functional activity with lesser complications as compared to ORIF technique.

In our study 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 thereby necessitating importance of this approach over ORIF approach in a developing resource poor country like India.

6. Source of Funding

None.

7. Conflict of Interest

The authors declare no conflict of interest.

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