

# Treatment Outcome of Displaced Proximal Humeral Fractures with Joshi's External Stabilization System: A Prospective Study

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## ABSTRACT

**Introduction:** Proximal humeral fracture accounts for four to five percentage of all fractures. Undisplaced fractures can be managed conservatively however, for displaced fractures; no particular method is a panacea. In our study we treated displaced proximal humeral fracture with Joshi's external stabilizing system. **Aims:** To evaluate functional outcome of displaced proximal humerus fractures managed by Joshi's external stabilizing system. **Methods:** This prospective study included all patients with displaced proximal humerus fracture (Neer's type two and three); treated with JESS from August 2018 to August 2021 at Nepalgunj Medical College, Kohalpur and functional outcome was evaluated using Neer's criteria at final follow-up. Ethical clearance was obtained from Institutional Review Committee. **Results:** A total of 40 patients, 23 males and 17 females with mean age of 41.2 years (range from 18 to 60) were included. Mean follow-up duration was  $24 \pm 1.7$  weeks. All fractures united at an average of  $13 \pm 1.7$  weeks. Twenty-nine patients (72.5%) had an excellent result with average score of  $92.7 \pm 2.3$  and remaining 11 (27.5%) had satisfactory functional outcome with average score of  $84.7 \pm 1.7$  according to Neer's criteria. Three patients had bicipital tendonitis that resolved within eight weeks of implant removal while two had pin tract infection which resolved with oral antibiotics and dressing. **Conclusion:** Joshi's external stabilizing system is an effective treatment option in patients with displaced proximal humeral fractures.

**Keywords:** External fixator, Joshi's external stabilization system, Proximal humerus fracture

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## INTRODUCTION

Proximal humeral fracture accounts for four to five percentages of all fractures in adults.<sup>1</sup> This injury is popularly classified according to Neer's criteria based on number of fracture parts and their displacement namely: humeral head, greater tuberosity, lesser tuberosity and humeral shaft. A fracture part is considered displaced if angulation exceeds 45 degrees or if displaced more than one centimeter.<sup>2,3</sup> Several studies have compared the different treatment strategies of displaced proximal humeral fractures, but no consensus however has been reached. Some of those techniques have been abandoned, while others appear to stand the test of time.<sup>4-6</sup> Use of an external fixator reduces extensive surgical dissection

and damage to vascular supply of the fracture fragments with already compromised perfusion.<sup>7-9</sup> Joshi's external stabilization system (JESS) was designed by Dr. BrijBhusan Joshi in 1988, a light weight mini external fixator with adequate stability which does not jeopardize vascularity to the fracture fragments. It also allows early mobilization of shoulder and less hospital stay. Implant removal is also hassle-free which can be done in outpatient basis.<sup>10-12</sup> Traditional conservative treatment technique by a hanging arm cast fails to give proper reduction leading to malunion and shoulder stiffness while more recent proximal humerus locking plates are not easily available; it requires ample dissection threatening blood supply to fracture fragments. With dissection there always prevails risk for infection and implant removal is also a major surgery.

This study aims to evaluate functional outcome of displaced proximal humerus fractures managed by Joshi's external stabilizing system.

**METHODS**

This was a prospective observational study conducted at Nepalgunj Medical College, Kohalpur from August 2018 to August 2021. Ethical clearance was obtained from Institutional review committee and an informed written informed consent was taken.

All patients with displaced proximal humerus fracture (Neer's type two and three); who were managed by JESS after closed or limited open reduction were included in this study. Patients with an open fracture, pathological fracture, fracture associated with shoulder dislocation and those patients with compromised shoulder functions before injury were excluded from this study. X-ray of shoulder in an anteroposterior and axillary lateral views were taken, and fracture was classified before surgery.

**Surgical technique**

Under general anesthesia or regional block patients were placed supine on radiolucent fracture table with a sandbag beneath scapula to elevate the shoulder. Painting and draping was done from axilla to hand. The fracture was reduced by traction and manipulation or transcutaneously with the help of a 2.5 millimeter threaded pin at humeral head. Those cases where an adequate reduction could not be achieved a limited open reduction was done and the fracture was reduced. The reduction was maintained with the help of an assistant. Three threaded pins with 2.5 millimeter diameter were passed into the humeral head purchasing greater and lesser tuberosities, which were angled almost 30-45 degrees with one another. The pins were connected by curved "C" shaped connecting rod. Two threaded pins of similar dimensions were placed in distal fragment which were connected to the pins in proximal fragment (figure 1). The stability was assessed by moving the shoulder joint under fluoroscopy. Arm pouch sling was given to every patient postoperatively.

Patients were encouraged for shoulder mobilization exercises as soon as pain was tolerable. Pin site dressing was instructed with providone iodine or chlorhexidinebased solution every alternate day from second post-operative day. Patients were followed at four weeks, eight weeks, and then eight week intervals for minimum of six months. Additional K- wires, if used were removed at four weeks. Radiological union was defined as the presence of bridging callus in three of the four cortices. Implants were removed after there was evidence of union. At the final follow up functional outcome was assessed using the Neer's criteria.

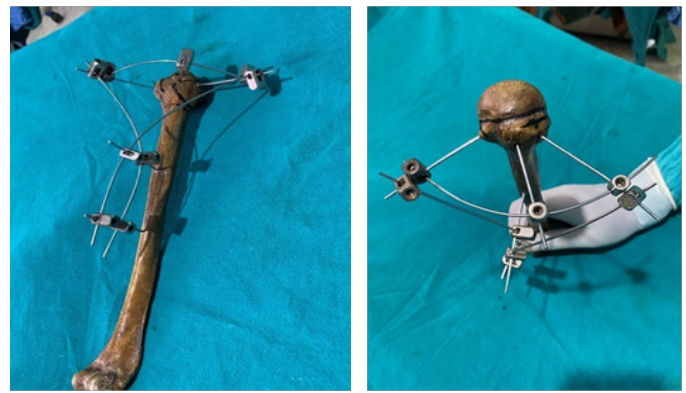


Figure 1: Fixation technique in humerus specimen

**Statistical analysis**

All statistical analyses were performed using Statistical Package for the Social Sciences (SPSS) version 25. P<0.05 was considered statistically significant. One sample student T test was used to compare mean of functional outcome at subsequent follow ups. Mean and standard deviation were calculated for all measured and calculated values.

**RESULTS**

A total of 40 patients, 23 males and 17 females with an average age of 41.22 years (18 – 60 years) with displaced proximal humerus fracture were included in this study. All patients were followed up for an average of 24 ± 1.74 weeks. All fractures united at an average of 13 ± 1.75 weeks. Implants were removed after union was achieved under slight sedation. At final follow up, 29 patients (72.5%) exhibited excellent result with mean Neer's score of 92.7 ± 2.3 points while the remaining 11 (27.5%) had satisfactory outcome with an average score of 84.7 ± 1.7 points.

	Outcome	
	Excellent	Satisfactory
Classification		
2 Part	22 (75.8%)	7 (24.2)
3 Part	7 (63.6)	4 (36.4)

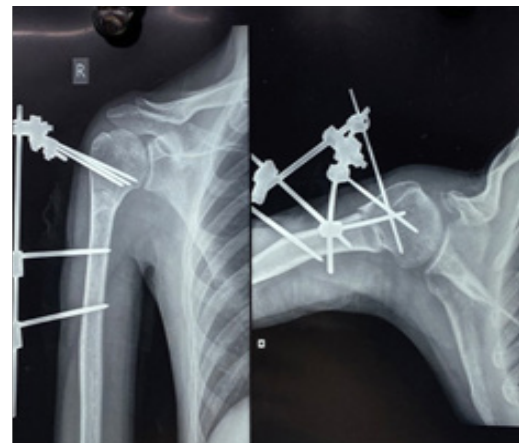
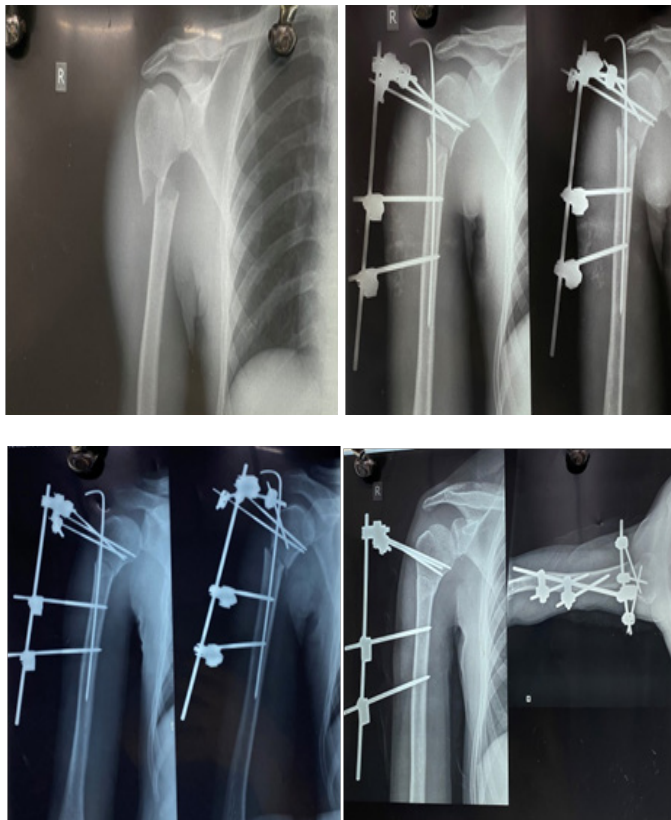
Table 1: Comparison of functional outcome according to the fracture type

The mean age of patients with excellent result was 39.1 years (range 19 – 54 years) and those with satisfactory result was 46.8 years (range 38 – 57 years). The mean Neer's score for the operated shoulder markedly improved from an average of 62.4 points ± 5.3 at eighth post-operative week to 90.5 points ± 4.2 at the final follow up. The comparison of mean of both scores seemed to be statistically significant (p<0.001).

Outcome		Flexion	Extension	Abduction	External rotation	Internal rotation
Excellent	Mean	172.41	45.52	162.41	48.10	80.34
	N	29	29	29	29	29
	Std. Deviation	10.907	9.851	8.305	6.184	9.056
Good	Mean	164.55	35.45	153.64	35.91	60.91
	N	11	11	11	11	11
	Std. Deviation	5.222	4.719	10.269	5.839	7.006
Total	Mean	170.25	42.75	160.00	44.75	75.00
	N	40	40	40	40	40
	Std. Deviation	10.250	9.803	9.608	8.161	12.195

**Table II: Degree of range of motion (ROM) of shoulder joint in degree at final follow-up expressed in terms of mean and Standard deviation, N (frequency)**

Three patients had bicipital tendonitis characterized by anterior shoulder pain radiating down the region of biceps, which resolved within eight weeks of removal of the implants and administration of anti-inflammatory medication. Two patients had superficial pin tract infections which were treated with oral antibiotics and regular dressing, one of them had exuberant granulation tissues at pin sites which were debrided during implant removal and landed in hypertrophic scars. There was no non-union or avascular necrosis documented in our studies.



**Figure 2: Sequential X-ray at eight weeks follow up interval**

**DISCUSSION**

Conservative management by a hanging arm cast was a popular method in management of these injuries for quite some time. Clifford P and Mills et al advocated conservative management with close reduction which was subsequently contradicted by Stableforth P because of loss of reduction, failure to early mobilization and high incidence of pseudoarthrosis.<sup>13-15</sup>

Recently, with the advancement in asepsis and newer implants this trend has gradually fallen out of favor. Neer concluded conservative management of displaced proximal humeral fracture to be inadequate for active and healthy patients, because of uncontrollable rotatory displacement in two part and three-part fractures.<sup>16</sup>

With advancement in asepsis and development of modern implants an open reduction and internal fixation evolved as an optimal treatment option, however Siegel et al, Wiggman et al and Koval et al have mentioned difficulty in achieving a rigid fixation in proximal humerus with thin shell of cortical bone yielding inadequate purchase for internally fixating screws.<sup>17-19</sup> Besides Karatagliis et al and Gupta et al have also stated that extensive surgical exposure may jeopardize the precarious vascularity of fracture fragments leading to avascular necrosis of the humeral head.<sup>5,11</sup> With extensive dissection there is always a risk of infection as well and implant removal are also associated with neurovascular injuries.

Use of external fixators allows an adequate reduction, stable fixation and early mobilization for management of proximal humeral fractures. Ebrahim et al, Zhang et al and Martin et al. have mentioned that use of external fixators can minimize the disadvantages of open reduction and internal fixation.<sup>7-9</sup> They have also stated that use of smaller diameter pins allows pin placement in more than one plane providing better rotational stability of the fracture, with a lower risk of soft tissue or vascular injury. Gosh et al, Gupta et al, Kandel et al and Sharma et al have advocated that external fixation with JESS adequately stabilizes proximal humeral fractures allowing early mobilization and minimal surgical trauma.<sup>10-12,20</sup> The frame is less cumbersome due to lighter framework and allows multidirectional pin placement and can be removed with slight sedation. In our

study, we used three pins of 2.5 millimeter diameter in proximal humeral fragment and two pins distally. All fractures united with average duration of  $13.1 \pm 1.7$  weeks, the result was comparable to that of Ghosh et al. and Monga et al.<sup>10,21</sup>

Gupta et al. in their series of 16 patients reported good to excellent functional outcome in 81%.<sup>11</sup> Monga et al reported satisfactory to excellent functional outcome in 80% cases.<sup>21</sup> Gosh et al reported 22 cases with type 3 fractures were 72.7% had excellent to satisfactory result.<sup>10</sup> Our study also exhibited similar results with excellent result in 82.85% patients, the results were comparable.

The functional outcome significantly improved at subsequent follow-ups with an average score of 62.4 points  $\pm$  5.3 at eighth post-operative week to 90.5 points  $\pm$  4.2 at the final follow up. There were no complications like non-union or avascular necrosis of humeral head. The results were identical to that of Zhang et al and Sharma et al.<sup>9,20</sup>

### LIMITATIONS

Limitations to this paper include a relatively small sample size, while a study with more power may produce more significant results. Another concern was, we did not employ a comparative design because of which we could not compare results with another type of surgery or even conservative management. Most of the patients were from remote places because of which regular physiotherapy was not possible which might have inflicted upon outcome.

### CONCLUSION

Our results lead to a conclusion that Joshi's external stabilizing system (JESS) is an effective treatment option in patients with displaced proximal humeral fractures.

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