

Comparative Study between Minimally Invasive Percutaneous Plate Osteosynthesis and Open Reduction Internal Fixation For Management Of Proximal Humerus Fracture

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Abstract

Background: Fractures of the proximal humerus comprise nearly 4% of all fractures and 26% of fracture of humerus. Surgical options ranges from open reduction internal fixation (ORIF), intramedullary device fixation, external fixation to hemi arthroplasty. We compared the clinical and radiological outcomes of minimal invasive plate osteosynthesis (MIPO) and open reduction and internal fixation (ORIF) in patients with proximal humerus fractures.

Material & Methods: This prospective study included 24 patients with 2 part and 3 part proximal humerus fracture treated with ORIF or MIPO technique, with 12 patients in each group. A matched pair analysis was performed and patients were followed up for 3 months, 6 months and 12 months both radiographically and clinically using Constant and Murley score.

Results: The average of patients was 47.2 years. Average blood loss and mean duration of surgery was 287.50 ml and 102.9 mins, in ORIF group and 198.33 ml and 93.75 mins in MIPO group. The mean Constant Murley Score at 12 months in the MIPO group was 77.00, while in the ORIF group it was 72.33. MIPO group experienced significantly less pain, higher satisfaction in activities of daily living, and greater range of motion. In the MIPO group, only one patient had infection whereas in ORIF group three patients, had complications with one each having infection, varus collapse and malunion

Conclusion: The use of MIPO with a locking compression plate in the management of proximal humerus fractures is a safe and superior option compared to ORIF.

Keywords: Proximal humerus, minimally invasive plate osteosynthesis (MIPO), locking compression plate

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Introduction

Fracture of the proximal humerus is the third most common fracture, which accounts for 5% to 9% of all fractures [1]. Treatment of complex fracture patterns (two, three or four part) of the proximal humerus is still a challenging and controversial problem, which can ranges from non-operative management, percutaneous fracture fixation, open reduction and internal fixation (ORIF), and arthroplasty

[2-6]. But osteoporosis-related proximal humeral fracture requires better methods of fixation to decrease the complications associated with fixation failure and long-term immobilization [7-9]. With the introduction and improved design of locking plate, closed manipulative reduction (CMR) technique and minimal invasive technology, the outcome in these fractures in osteoporosis has improved.

Although minimal invasive plate osteosynthesis (MIPO) and open reduction and internal fixation (ORIF) show difference in outcomes and complications in the treatment of proximal humerus fractures, but it remains unclear whether MIPO is superior to ORIF [10-13]. Thus the goal of this study was to evaluate the clinical efficacy of CMR techniques combined with MIPO and to compare it with ORIF in the treatment of proximal humeral fractures.

Materials & Methods

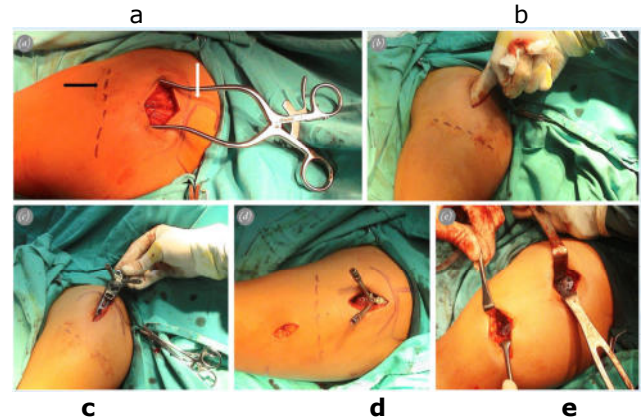
This is a prospective randomized comparative study was conducted at our center on 24 patients of proximal humerus fracture presenting from December 2016 to August 2018. Before including them in this study, informed consent and institutional ethical committee clearance was obtained.

All skeletally mature patients with Neer's type II or III displaced proximal humerus fractures were included in the study. Pathologic fractures, open fractures or with associated neurovascular injury or poly trauma were excluded from study. All fractures were classified using NEER'S classification and were randomized to receive treatment either by MIPO or ORIF, both of which was done under brachial block or general anesthesia in supine position [14].

In MIPO surgery, the first step was closed manipulative reduction (CMR) following which a longitudinal skin incision was given from the lateral edge of the acromion and extending distally for about 3-4 cm. On deep dissection, the deltoid musculature was split along its fibers and greater tuberosity was exposed. Proximal humerus locking plate was inserted along the humeral shaft proximally to distally. The plate was positioned just beneath between the periosteal preventing the axillary nerve. Plate position was assessed fluoroscopically. When C-arm fluoroscopy showed the correct relative position of the plate and fracture, the proximal five to six locking screws were placed into the head and with a 2 cm-long incision distally over the distal holes in plate three or four

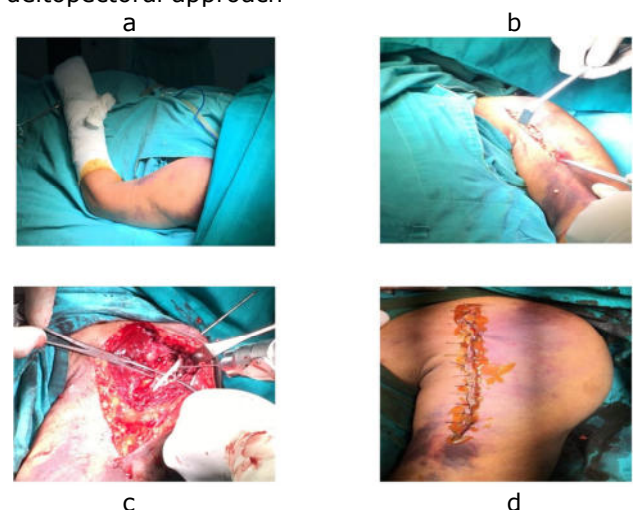
screws were placed onto the humeral shaft (fig 1).

Fig 1 – Intra-operated photo (a to e) showing minimal invasive plate osteosynthesis technique (MIPO)



For ORIF group, standard deltopectoral approach was used between pectoralis major and deltoid and the proximal humeral fracture was exposed and reduced directly. After confirming of satisfactory reduction by C-arm perspective, an appropriate length of the proximal humeral locking plate was selected and placed on the lateral aspect of the greater tuberosity and fixed with locking screws into the humeral head and shaft (fig 2). Post-operatively, shoulder was immobilized by shoulder immobilizer for three days; thereafter patients were encouraged to start passive shoulder exercises and then slowly full range of motion as per pain tolerance of patient.

Fig 2 – Intra-operated photo (a to d) showing open reduction and internal fixation (ORIF) via deltopectoral approach



Both MIPO and ORIF groups were compared for intraoperative parameters surgical incision length, blood loss and operative time. Clinical and radiological assessment was done regular intervals at 6, 10, 14 weeks and six months postoperatively. Union was said when clinically there was no pain or tenderness and radiologically, when bridging callus was present at fracture site in at least three cortices in both views. At the final follow-up, the functional outcome was evaluated using the Constant- Murley score.

Fig 3 – Shoulder and arm AP view pre-operative (a), immediate postoperative (b), and at one year follow-up (c) of proximal humerus fracture treated with ORIF and locking plate. Clinical photo (d to e) showing good results.

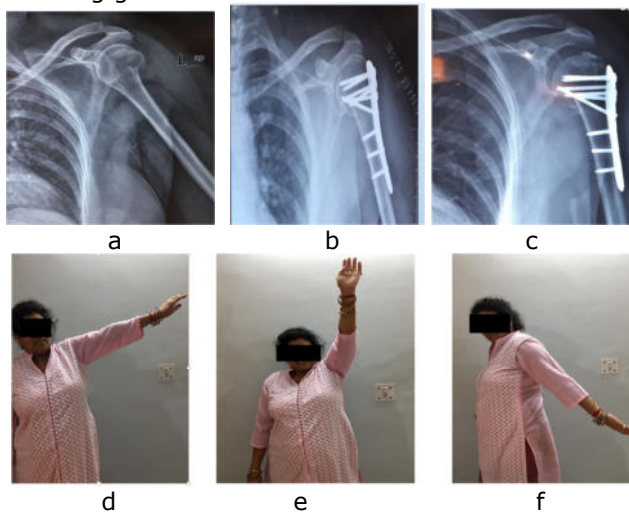
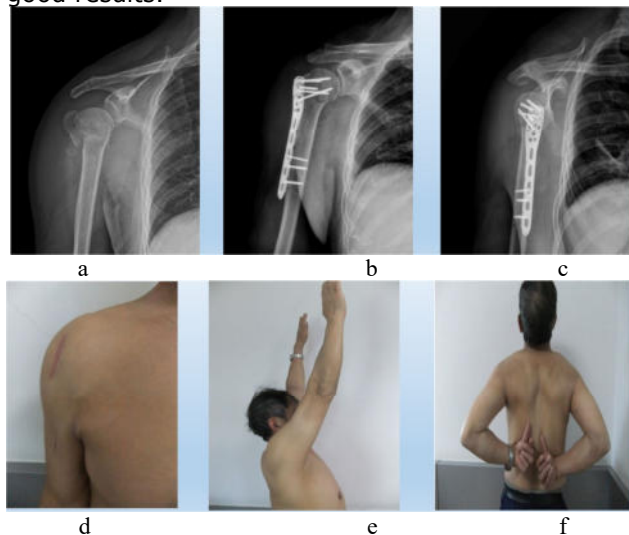


Fig 4 – Shoulder and arm AP view pre-operative (a), immediate postoperative (b), and at one year follow-up (c) of proximal humerus fracture treated with MIPO technique. Clinical photo (d to f) showing good results.



Results

A total of 24 patients, were included in the study, with 12 patients in each groups of MIPO and ORIF. The overall average age was 47.2 years with average age in the MIPO group to be 45.33 years and 50.25 years in the ORIF group (table 1). As per Neer classification, there were 7 (58.3%) cases of type II fractures and 5 (41.7%) of type III fractures in the MIPO group, while the ORIF group included 4 (33.3%) cases of type II fractures and 8 (66.7%) cases of type III fractures. There was no significant difference between the MIPO and ORIF group in gender, age and Neer type of fractures.

There were significant differences between the two groups in volume of blood loss and operative time. Compared with the ORIF group which had an average of 287.50ml of blood loss and 102.9 min of mean surgery time, the MIPO group had less blood loss with an average of 198.33 ml and shorter operation time with an average of 93.75 minutes, both of which was significant with $p < 0.05$ (fig 3 & 4).

The Constant score was higher in the MIPO group at 3 and 6 month follow-up compared to the ORIF group. In addition, patients in the MIPO group experienced significantly less pain, higher satisfaction in activities of daily living, and greater range of motion at the 3 and 6 months follow-up ($p < 0.05$). Although, the level of strength was not significantly different at same time ($p > 0.05$).

The mean Constant Murley Score at 12 months in the MIPO group was 77.00 ± 4.75 , while in the ORIF group it was 72.33 ± 8.00 , which was not statistically significant ($p > 0.05$). In the MIPO group, only one patient had infection whereas in ORIF group three patients, had complications with one each having infection, varus collapse and malunion (table 1).

Table 1 – Comparison of results of MIPO and ORIF (MIPO – minimal invasive plate osteosynthesis / ORIF – open reduction and internal fixation)

	MIPO	ORIF	p value
Total patients	12	12	-
Mean age (years)	45.33	50.25	
Male	8 (66%)	7 (58%)	-
Female	4 (33%)	5 (41%)	
Right	7 (58%)	6 (50%)	-
Left	5 (41%)	6 (50%)	
Mode of injury			
a. Fall from height	1 (8%)	1 (8%)	
b. Vehicle accident	5 (41%)	7 (58%)	
c. Self-fall	6 (50%)	4 (33%)	
Neer's classification			
a. Two part	7 (58%)	4 (33%)	
b. Three part	5 (41%)	8 (66%)	
Intra-operative parameter			
a. Mean Surgical Time (min)	93.7	102.9	0.007
b. Mean Blood Loss (ml)	198.33	287.5	0.006
Mean Union time (weeks)	11.0	11.92	0.13
Constant Murley score	77.00	72.3	
a. Poor (<55)	0 (0%)	0 (0%)	0.096
b. Moderate (56- 70)	1 (8%)	2 (16%)	
c. Good (71-85)	11 (91%)	10 (83%)	
d. Excellent (>85)	0 (0%)	0 (0%)	
Complications			
a. None	11 (91%)	9 (75%)	
b. Malunion	0 (0%)	1 (8%)	
c. Infection	1 (8%)	1 (8%)	
d. Varus collapse	0 (0%)	1 (8%)	

Discussion

Proximal humerus fractures are common fractures and treatment should concentrate on maximizing the functional outcomes with minimal pain and disability [2-7]. In the present study, we compared the outcome of proximal humerus fractures treated with MIPO and ORIF in comparable groups with no significant differences between the groups in gender, age and Neer's type of fracture.

Intra-operative parameters (duration of surgery, blood loss), post-operative functional outcome and union time of MIPO group was better than that of ORIF, which was statistically significant. Although, the functional outcomes of these two groups as evaluated by Constant-Murley scores showed that MIPO brought better results than ORIF but the difference was not significant at one year follow up.

Further the postoperative complications like infection, varus collapse and malunion were lesser in MIPO group. In our study, in MIPO group also, few postoperative complications occurred, including superficial

infection, numbness of anterior edge skin, and slight pain. Many reported cases treated with this technique had similar complications [15-19].

Superior result of MIPO over ORIF, as seen by our and other studies is due to decreased surgical trauma to the soft tissue and preservation of periosteal circulation in MIPO [20]. This could also lead to higher complications like nonunion, necrosis, pain and infections in ORIF group as compared to MIPO group, which is also supported by many reports [7,15-19]. The better outcome and lower complications of the MIPO group may be either due to the fact that there was better reduction with less operative time, or to the fact that less damage is caused to the blood supply of the fracture fragments [13,21,22]. The MIPO technique may retain more osteogenic fracture healing factors at the fracture site than ORIF [23].

Conclusion

Our study shows that MIPO with LCP requires less surgery time, causes less blood loss, shortens hospital stay, results in less scarring,

and is cosmetically more appealing and acceptable to female patients compared to ORIF. Further, MIPO provides better

functional results and has less morbidity at one year follow-up, although our study is limited by a lesser number of patients.

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