

## A Comparative Study in Management of Fracture of Shaft of Humerus: Bridge Plate (MIPO) and Conventional Plating

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Conflict of interest: Nil

### Abstract:

**Background:** The purpose of this study was to compare the clinical results and functional outcomes of two groups of patients: those treated with MIPO and the other treated with ORIF.

**Methods:** This is a hospital based prospective longitudinal study. Patients with 20- 70 years of age having closed fractures of humerus attending Department of orthopaedics as OPD/IPD patients' basis were included in study group after taking informed written consent. Patient's functional results were evaluated. After that data were collected and result was analysed.

**Results:** In present study, significantly lower mean operative time  $105.4 \pm 7.76$  min in the MIPO group as compared to  $123.8 \pm 7.27$  min in the conventional group ( $P < 0.001$ ). Mean UCLA score at 6 weeks in MIPO group was  $17.17 \pm 2.72$  and in conventional group was  $15.5 \pm 2.78$ , At 12 weeks in MIPO group was  $23.27 \pm 3.12$  and in conventional group was  $21.4 \pm 3.56$ . At 6 months in MIPO group was  $31.03 \pm 2.72$  and in conventional group was  $29.63 \pm 2.59$ . Mean Mayo elbow score at 6 weeks in MIPO group was  $77.33 \pm 6.79$  and in conventional group was  $71.33 \pm 5.07$ . At 12 weeks in MIPO group was  $85.33 \pm 7.18$  and in conventional group was  $80.33 \pm 5.86$ . At 6 months in MIPO group was  $94.5 \pm 7.11$  and in conventional group was  $87.5 \pm 5.69$ . 5 patients in the conventional group and 2 patients in MIPO group developed an infection. four patients in conventional and two patients in the MIPO group showed screw loosening. In one patient of each group, malunion was present. 4 patients in conventional group and 1 patient in MIPO group non-union was present. 4 patients in conventional group and 2 patients in MIPO group radial nerve palsy was present. Mean time of union was significantly lower in conventional group ( $16.12 \pm 0.82$  mint.) as compared to MIPO group ( $16.66 \pm 1.17$  mint).

**Conclusion:** Minimally invasive plate osteosynthesis may achieve comparable results with the open plate osteosynthesis method in simple as well as complex fractures of humeral shaft. Although MIPO potentially has the radiation hazard, it may reduce the perioperative complications with a shortened operation time.

**Keywords:** MIPO, Shaft of Humerus, Conventional Plating.

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### Introduction

In the last few decades, rapid industrialization and the fast pace of life have brought both comforts and catastrophe like road traffic accidents and crippling many young lives.

Humeral shaft fracture is one of the common injuries encountered in orthopedic surgery accounting for 1% - 5% of all fractures. Although nonoperative treatment of humeral shaft fracture is associated with satisfying clinical and functional outcomes in most cases, usually results in varus deformity and limitation of shoulder and elbow motion in some patients. Thus, orthopedic surgeons prefer operative management due to early return to function and low compliance of the patients.[1]

In the early 1960s, there was a great reluctance towards operative management of these fractures because of high incidence of infection, non-union,

malunion, inadequate fixation and lack of proper instruments, implant as well as antibiotics. Then, the traditional management of displaced supracondylar fracture of femur was along the principle of Watson Jones<sup>1</sup> & John Charnley [2].

This comprised of skeletal traction, manipulation of fracture and external immobilization in the form of casts and cast bracings. These methods however, met with problems like deformity, shortening, prolonged bed rest, knee stiffness, angulation, joint incongruity, malunion, quadriceps wasting, knee instability and post-traumatic osteoarthritis.

Various methods are used to treat humeral shaft fractures. Most of the fractures can be effectively treated conservatively. [1-2] Operative intervention is indicated in special circumstances including failure of closed reduction, intra-articular extension,

neurovascular compromises, floating elbow, pathological fractures, open fractures, bilateral humeral shaft fractures, and polytraumatized patients.[3] These fractures can be surgically treated by means of plating osteosynthesis [4], intramedullary nails, or external fixation (5–8). Open reduction and internal fixation (ORIF) continue to be considered the gold standard for surgical treatment. The advantages include anatomical reduction of fractures and less interference to elbow and shoulder function. [5-9] The major disadvantages of this technique are extensive soft tissue stripping and disruption of periosteal blood supply, which increase the risk of nonunion and iatrogenic radial nerve palsies. [10-12] It has been reported that humeral shaft fractures can be successfully treated with minimally invasive plate osteosynthesis (MIPO) [13-17] This technique has advantages of less soft tissue dissection and avoids the need to expose the radial nerve; thus, there is also low risk of iatrogenic radial nerve palsies and deep infection.

The purpose of this study was to compare the clinical results and functional outcomes of two groups of patients: those treated with MIPO and the other treated with ORIF.

#### Material and Methods

- Study design: hospital based Prospective observational longitudinal study.
- Sample size: 30 cases for each group

#### Inclusion Criteria

- All the patients with 18- 70 years having closed fractures humerus will be included in study.
- Patient consenting to be included in study.

#### Exclusion Criteria

- Patients with pathological fractures

- Open fracture
- Neurovascular injury
- Distal humerus fracture with intraarticular extension
- Fracture proximal third of humerus
- Skeletally immature patients
- Patients having any medical contraindications to surgery.

#### Method

This is a hospital based prospective longitudinal study. Patients with 20- 70 years of age having closed fractures of humerus attending Department of orthopaedics as OPD/IPD patients' basis will be included in study group after taking informed written consent. Patients with pathological fracture, with injury of vessel, any medical contradiction to surgery. Selected patients will undergo pre-operative X- Ray – AP and lateral view and all other routine investigations. They will then be considered for surgery and will be followed for six months post operatively. Patient's functional results will be evaluated. After that data will be collected and result will be analysed.

#### Statistical Analysis

- The collected data will be revised, coded, tabulated and introduced to a PC as master sheet.
- Quantitative variables will be expressed as expressed as mean and SD.
- Qualitative variables will be expressed as frequencies and percents.
- Appropriate statistical tests will be applied to obtain results.
- A significance level of  $P < 0.05$  will be used in all tests.

#### Results

**Table 1: Socio-demographic profile**

Variable	MIPO	Conventional	p-value
Age in years	34.83 ± 13.59	38.5 ± 14.46	0.657
Male : Female	23 : 7	22 : 8	0.99

In our study, maximum 36.7% patients in MIPO group and 33.33% patients in conventional group were from 30-39 Yrs age group. The age wise differences in both group was found statistically

Insignificant. 76.7% patients in MIPO group and 73.3% patients in conventional group were male and remaining were female. The sex wise differences in both group was found statistically Insignificant

**Table 2: Distribution of study subjects according to fracture type (AO Classification)**

AO classification	MIPO		Conventional		Total	
	N	%	N	%	N	%
A1	4	13.3	1	3.3	5	8.3
A2	8	26.7	8	26.7	16	26.7
A3	6	20.0	15	50.0	21	35.0
B1	6	20.0	3	10.0	9	15.0
B2	6	20.0	3	10.0	9	15.0
Total	30	100	30	100	60	100

Chi-square = 7.657 with 4 degrees of freedom; P = 0.105 (NS)

In present study, maximum patients (26.7%) patients in both groups were A2 type fracture followed by

20.00% patients in MIPO group and 50.00% patients in conventional group were A3 type of fracture. The type of fracture wise differences in both group was found statistically Insignificant

**Table 3: Comparison of mean duration of surgery (minutes) among study groups**

Group	N	Mean	Std. Deviation
MIPO	30	105.4	7.76
Conventional	30	123.8	7.27
t-test - t = -9.492 with 58 degrees of freedom; P < 0.001 (S)			

In present study, significantly lower mean operative time 105.4±7.76 min in the MIPO group as

compared to 123.8±7.27 min in the conventional group (P < 0.001).

**Table 4: Comparison of UCLA shoulder score among study groups**

Follow up time	MIPO	Conventional	P value
6 weeks	17.17 ± 2.72	15.5 ± 2.78	0.022 (S)
12 weeks	23.27 ± 3.12	21.4 ± 3.56	0.035 (S)
6 months	31.03 ± 2.72	29.63 ± 2.59	0.046 (S)

In present study mean UCLA score at 6 weeks in MIPO group was 17.17 ± 2.72 and in conventional group was 15.5 ± 2.78, At 12 weeks in MIPO group was 23.27 ± 3.12 and in conventional group was 21.4

± 3.56. At 6 months in MIPO group was 31.03 ± 2.72 and in conventional group was 29.63 ± 2.59. The difference in both group was found statistically Significant.

**Table 5: Comparison of Myao elbow score among study groups**

Follow up time	MIPO	Conventional	P value
6 weeks	77.33 ± 6.79	71.33 ± 5.07	<0.001 (S)
12 weeks	85.33 ± 7.18	80.33 ± 5.86	0.005 (S)
6 months	94.5 ± 7.11	87.5 ± 5.69	<0.001 (S)

In present study mean Myao elbow score at 6 weeks in MIPO group was 77.33 ± 6.79 and in conventional group was 71.33 ± 5.07. At 12 weeks in MIPO group was 85.33 ± 7.18 and in conventional group was

80.33 ± 5.86. At 6 months in MIPO group was 94.5 ± 7.11 and in conventional group was 87.5 ± 5.69. The difference in both group was found statistically Significant.

**Table 6 – Incidence of complications among study groups**

Complications	MIPO		Conventional		P value
	N	%	N	%	
Infection	2	6.7	5	16.7	0.424
Non union	1	3.3	4	13.3	0.353
Mal union	1	3.3	1	3.3	1.000
Radial nerve palsy	2	6.7	4	13.3	0.671
Screw loosening	2	6.7	3	10.0	1.000

5 patients in the conventional group and 2 patients in MIPO group developed an infection. four patients in conventional and two patients in the MIPO group showed screw loosening. In one patient of each group, malunion was present. 4 patients in

conventional group and 1 patients in MIPO group nonunion was present. 4 patients in conventional group and 2 patients in MIPO group radial nerve palsy was present

**Table 7: Comparison of mean time to union (weeks) among study groups**

Group	N	Mean	Std. Deviation
MIPO	29	16.66	1.17
Conventional	26	16.12	0.82
t-test - t = 1.958 with 53 degrees of freedom; P = 0.055 (NS)			

In present study, mean time of union was significantly lower in conventional group (16.12±0.82 mint.) as compared to MIPO group (16.66±1.17 mint)

**Table 8 – Distribution of study subjects according to radiation exposure**

Radiation exposure	MIPO		Conventional		Total	
	N	%	N	%	N	%
No	0	0	30	100	30	50
Yes	30	100	0	0	30	50
Total	30	100	30	100	60	100

Fisher Exact Test --  $P < 0.001$  (S)

In present study 100.00% in MIPO group radiation exposure was present and in conventional group no radiation exposure was present.

### Discussion

In our study, maximum 36.7% patients in MIPO group and 33.33% patients in conventional group were from 30-39 Yrs age group. 76.7% patients in MIPO group and 73.3% patients in conventional group were male and remaining were female. Maximum patients (26.7%) patients in both groups were A2 type fracture followed by 20.00% patients in MIPO group and 50.00% patients in conventional group were A3 type of fracture. Maximum 83.3% patients in MIPO group and 76.7% patients in conventional group were presented with RTA injury. The mode of injury wise differences in both group was found statically Insignificant.

Humeral shaft fractures have been reported to be more common in males with a peak incidence in the third decade. Road traffic accident was a common cause for such fractures in our and other similar studies. A variation in epidemiological features of humeral shaft fractures is noted with different geographical locations. [10]

Khan SM et al [11] was observed that age of the patients was ranging from 20 years of minimum to 83 years of maximum with an average age of 51.4 years. 20 males (66.6%) and 10 females (33.3%) and male to female ratio of the patients was 2:1. their study the main mechanism of injury is road traffic accident in 19 cases (66.67%). Fall includes 7 cases (20%) and 3 cases (13.33%) had history of assault and 1 case with electric burns. Thus, showing high velocity injury as the main mechanism.

Bone graft is not infrequently required to promote fracture healing during the conventional open plating of humeral fractures, such as in comminuted fractures or for treating unwanted gaps after plate fixation. However, autogenous iliac bone grafts (AIBG) may have significant morbidity of donor site. We also used bone graft to prevent possible delayed union or nonunion in one-sixth of the patients in the conventional group, which is a higher proportion than that reported previously. Consequently, our findings confirm that MIPO

prevents the need of bone graft with the high union rate. [12]

Mal-alignment is a common complication of MIPO when applied to long bone fractures. However, in the present study, mal-alignment was not observed in the MIPO group, which concurs with previous report. On the other hand, a long time for fluoroscopic control is inevitable for MIPO to have a satisfactory alignment. This may reflect the relatively long radiation exposure time of MIPO group in this study. [12]

The functional outcomes of shoulders and elbows were satisfactory in both study groups, which is consistent with previous reports on plating techniques. Although intramedullary nailing is generally considered a minimally invasive procedure, problems with shoulder or elbow function can occur when nails are inserted in an antegrade or retrograde fashion. [13] However, a recent report of MIPO of humeral shaft fractures showed an early recovery of shoulder and elbow joint. Although both methods do not involve fracture site exposure, MIPO may be superior to nailing in terms of reducing functional impairments. However, this topic requires further prospective comparative study.

Surgeons have cautioned regarding the risk of radial nerve injury when either conventional or MIPO are used for treating humeral shaft fractures. An et al. [13] insisted that MIPO may have lower risk of iatrogenic radial nerve palsy. However, in the present study, we experienced two cases in MIPO and 4 cases in conventional group of iatrogenic radial nerve palsy and we cannot comment on the relative safeties of the two treatment methods. After this case, there has been no occurrence of iatrogenic radial nerve palsy in our institution, as other studies have also reported a low incidence for MIPO. [14-15] Therefore, we think that humeral MIPO is a safe method, in terms of radial nerve safety.

### Conclusion

Minimally invasive plate osteosynthesis may achieve comparable results with the open plate osteosynthesis method in simple as well as complex fractures of humeral shaft. Although MIPO potentially has the radiation hazard, it may reduce

the perioperative complications with a shortened operation time.

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