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A Comparative Study In Management of Fracture of Shaft Of Humerus: Bridge Plate (MIPO) And Conventional Plating

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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±7.76 min in the MIPO group as compared to 123.8±7.27 min in the conventional group (P <0.001). 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 ± 3.12and 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. 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 ± 7.11and in conventional group was 87.5 ± 5.69. 5 patient in the conventional group and 2 patients in MIPO group developed an infection.

Four patients in conventional and two patient 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 were 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±0.82 mint.) as compared to MIPO group(16.66±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

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 no operative 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 Jones1 & 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) continues 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 Area:** Department of orthopaedics - SMS Medical College, Jaipur, Rajasthan.
- Study Duration: April 2018 / approval by ethical committee to September 2019 or till the sample size is achieved(whichever is earlier).
- **Study Design:** hospital based Prospective observational longitudinal study.
- **Study Population:** patients attending at Department of orthopaedics, SMS Medical College, Jaipur.
- **Sample size:** 30 cases for each group

Sample size was calculated 23 subjects for each of two groups at alpha error 0.05 and power 80% assuming minimum difference and mean to be calculated in operation duration in MIPO and ORIF (conventional plating). 50 minutes with SD 60 minutes (As per seed article).

So for study plan 30 for each of two groups.

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: Age distribution of study groups

Age group (years)	MIPO		Conventional		Total	
	N	%	N	%	N	%
<30	12	40	8	26.7	20	33.3
30 – 39	11	36.7	10	33.3	21	35.0

40 – 49	2	6.7	5	16.7	7	11.7
≥ 50	5	16.7	7	23.3	12	20.0
Total	30	100	30	100	60	100
Mean± SD	34.83 ± 13.59		38.5 ± 14.46		36.68 ± 14.23	

Chi-square = 2.467 with 3 degrees of freedom; P = 0.656 (NS)

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 stastically Insignificants.

Table 2: Gender wise distribution of study groups

Gender	MIPO		Conventional		Total	
	N	%	N	%	N	%
Female	7	23.3	8	26.7	15	25.0
Male	23	76.7	22	73.3	45	75.0
Total	30	100	30	100	60	100

Chi-square = 0.000 with 1 degree of freedom; P = 1.000 (NS)

In present stud, 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 stastically Insignificants

Table 3 – 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 stastically Insignificants

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 week	17.17 ± 2.72	15.5 ± 2.78	0.022 (S)
12 week	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 ± 3.12and 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 stastically Significants.

Table 5: Comparison of Myao elbow score among study groups

Follow up time	MIPO	Conventional	P value
6 week	77.33 ± 6.79	71.33 ± 5.07	<0.001 (S)
12 week	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 ± 7.11and in conventional group was 87.5 ± 5.69. The difference in both group was found stastically Significants

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 patient in the conventional group and 2 patients in MIPO group developed an infection. four patients in conventional and two patient 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 non union 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

The common indications for operative treatment were failure to achieve acceptable reduction by closed methods and patients with multiple injuries. Accepted indications for surgical management of humeral shaft fractures are (i) unsatisfactory alignment or reduction by non-operative methods, (ii) associated injuries in the extremity requiring early mobilisation, (iii) segmental fracture, (iv) pathological fracture, (v) fracture associated with major vascular injuries, (vi) humeral fractures with radial nerve palsy developing after manipulation or application of cast, (vii) polytrauma and (viii) floating elbow.[10]

Plate osteosynthesis has been the treatment of choice for humeral shaft fractures when operative treatment is needed. However, complications such as healing problems, infections and iatrogenic radial nerve palsy have been reported. [11] Therefore, plate osteosynthesis of comminuted humeral fracture is a challenging operation, which requires surgical experience and meticulous attention to periosteum, muscles and nerves. Minimally invasive plate osteosynthesis (MIPO) is an emerging procedure for the treatment of humeral shaft fractures. One of the main advantages of MIPO is that it preserves soft tissue and the periosteal circulation, which promotes fracture healing. In the MIPO group of this study, most cases achieved primary bony union and it concurs with reports on MIPO. [12-14]

MIPO is generally known to achieve better results for comminuted fractures of humeral shaft, whereas simple fractures are better treated with open, compression plating. In the present study, we evaluated the union rate and time according to the fracture classification, which were satisfactory in both methods.

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 was 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 stastically Insignificants.

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.[13]

Khan SM et al[14] 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.[15]

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.[16]

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. [17] 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. [18] 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 .[19-20] Therefore, we think that humeral MIPO is a safe method, in terms of radial nerve safety.

The overall incidence of primary radial nerve palsy in the present study is comparable to those reported by previous studies. [21-22] Exploration of the radial nerve is commonly performed in these circumstances and nerve transposition may be performed. However, Ekhlom et al. [23] insisted that radial nerve palsy does not require exploration during primary surgical intervention, unless a high-energy injury or open fracture is involved. With this in mind, we excluded these injuries from the present study and all patients with radial nerve palsy recovered spontaneously in the MIPO group, without intraoperative radial nerve exploring. However, we still consider the exploration of radial nerve, when it is associated with the severe open fracture or distraction injury.

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.

References

1. Ekholm R, Tidermark J, Törnkvist H, Adami J, Ponzer S. Outcome after closed functional treatment of humeral shaft fractures. J Orthop Trauma 2006; 20:591–596.
2. Toivanen JA, Nieminen J, Laine HJ. Functional treatment of closed humeral shaft fractures. Int Orthop 2005; 29:10–13.
3. Schemitsch EH, Bhandari M. Fractures of the humeral shaft. In: Browner BD, Jupiter JB, Levine AM, Trafton PG, editors. Skeletal trauma: basic science, management, and reconstruction. 3rd ed. Philadelphia: WB Saunders Company; 2003. 1487–1488.
4. Niall DM, O'Mahony J, McElwain JP. Plating of humeral shaft fractures – has the pendulum swung back?. Injury 2004; 35:580–586.
5. Changulani M, Jain UK, Keswani T. Comparison of the use of the humerus intramedullary nail and dynamic compression plate for the management of diaphyseal fractures of the humerus. A randomised controlled study. Int Orthop 2007; 31:391–395.
6. Fernandez FF, Matschke S, Hulsenbeck A, Egenolf M, Wentzensen A. Five years' clinical experience

with the unreamed humeral nail in the reatment of humeral shaft fractures. Injury 2004; 35:264–271.

7. Petsatodes G, Karataglis D, Papadopoulos P, Christoforides J, Gigis J, Pournaras J. Antegrade interlocking nailing of humeral shaft fractures. J Orthop Sci 2004; 9:247–252.
8. Pogliacomi F, Devecchi A, Costantino C, Vaienti E. Functional long-term outcome of the shoulder after antegrade intramedullary nailing in humeral diaphyseal fractures. Chir Organi Mov 2008; 92:11–16.
9. Bhandari M, Devereaux PJ, McKee MD, Schemitsch EH. Compression plating versus intramedullary nailing of humeral shaft fractures – a metaanalysis. Acta Orthop 2006; 77:279–284.
10. G. Tytherleigh Strong. "The Epidemiology of Humeral shaft fracture". JBJS. 1998; March;80B(2).
11. Kenneth J. Koval, Maureen, "Functional outcome after minimal displaced fractures of proximal humerus". JBJS. 1997 Feb;79(2):203-7.
12. Herbert Resch. "Percutaneous pinning of 3-4 part fractures of the proximal humerus". JBJS. 1997 March.
13. Darder A. Darder AJ. "Four part displaced proximal humerus fractures; operative treatment using Kirschner wire and a tension band". J Orthop Trauma. 1993;7(6):497-505.
14. Krishtiansen B, Kofoed H. "External fixation of displaced fractures of proximal humerus. Technique and preliminary results". JBJS Br. 1987 Aug;69(4):643-6
15. J. W. Owen. New Cross Boltable Intra-Medullary Nail for humeral fractures. JBJS (BR). 1995;77
16. Khan SM, Sheikh S, Shaik Saheb SH. A clinical study of management of proximal humeral fractures in adults. Int J Res Med Sci 2014;2:422-8.
17. Livani B, Belangero W, Andrade K, Zuiani G, Pratali R (2008) Is MIPO in humeral shaft fractures really safe? Postoperative ultrasonographic evaluation. Int Orthop Epub Aug
18. An Z., Zeng B., He X., Chen Q., Hu S. Plating osteosynthesis of mid-distal humeral shaft fractures: minimally invasive versus conventional open reduction technique *Int Orthop* 2010 ; 34 : 131-135
19. Chao TC, Chou WY, Chung JC, Hsu CJ. Humeral shaft fractures treated by dynamic compression plates, Ender nails and interlocking nails. Int Orthop. 2005;29(2):88–91. doi: 10.1007/s00264-004-0620-8.
20. Changulani M, Jain UK, Keswani T. Comparison of the use of the humerus intramedullary nail and dynamic compression plate for the management of diaphyseal fractures of the humerus. A randomised controlled study. Int Orthop. 2007;31(3):391–395. doi: 10.1007/s00264-006-0200-1.
21. Chapman JR, Henley MB, Agel J, Benca PJ. Randomized prospective study of humeral shaft fracture fixation: Intramedullary nails versus plates. J Orthop Trauma. 2000;14:162–166.
22. Pollock FH, Drake D, Bovill EG, Day L, Trafton PG. Treatment of radial neuropathy associated with fractures of the humerus. J Bone Joint Surg Am. 1981;63(2):239–243.
23. Ekholm R., Ponzer S., Törnkvist H., Adami J., Tidermark J. The Holstein-Lewis humeral shaft fracture: aspects of radial nerve injury, primary treatment and outcome *J Orthop Trauma* 2008 ; 22 : 693-697