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## Middle third humerus fractures in adults: Intramedullary nails vs. locking compression plates

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### Abstract

**Background:** 2 to 3% of all traumatic fractures in adults encountered by orthopaedic surgeons are humerus fractures. Operative management for these fractures has now gained popularity among surgeons to allow patients an early recovery and return to pre-morbid conditions. We compared the two commonly used implants for treating humerus shaft fractures, that is, locking compression plates and intramedullary nails in terms of complications associated and range of movements.

**Materials and methods:** 40 patients were allotted into 2 groups, with 20 undergoing treatment with locking compression plates and 20 undergoing intramedullary nailing. The 2 groups were comparable when pre-operative demographics were analysed. Post-operative follow up showed the following results.

**Results:** Axillary nerve injuries were noted in 4 out of the 20 patients in the nailing group and radial nerve palsy was noted in 1 patient in the plating group after surgery. 2 cases of superficial wound infection and 1 case of deep wound infection were recorded in the plating group. 1 patient in each group were found to have delayed union. A significantly higher incidence of shoulder stiffness was recorded in the intramedullary nailing group. A significant difference in the DASH score was recorded, in favour of the plating group. This could be attributed to the pain free movements at shoulder joint. A significant difference in the Rodrigues Merchan outcome was seen, in favour of the plating group, with 70% patients having achieved good to excellent outcome, as opposed to 25% in the nailing group. A higher incidence of poor outcomes was seen in the nailing group due to shoulder related complications.

**Conclusion:** We concluded that Open reduction and internal fixation with locking compression plates gave a better outcome to patients when followed up after surgery as compared to closed reduction and internal fixation with interlocking nails, primarily due to the shoulder related complications associated with intramedullary nailing.

**Keywords:** Shaft humerus, Intramedullary nails, Locking compression plates

### Introduction

2 to 3% of all traumatic fractures in adults encountered by orthopaedic surgeons are humerus fractures [1]. A bimodal distribution of these fractures is seen, in young males between 20-30 years and elderly females aged above 60 years [2]. Historically, an acceptable functional outcome and a union rate of upto 90% has been recorded in literature by conservative management, that is functional bracing [3]. An increasing trend is now being observed among surgeons to opt for an operative management of shaft humerus fractures in view of early rehabilitation, less complication rate and early return to pre-morbid status. Of the currently available options in treating humerus fractures, open reduction with locking compression plates and closed reduction with intramedullary nails are the most commonly used today. This study was done to compare the disability, complications and final range of movements between the patients operated by these two methods.

### Materials and Methods

This retrospective study was conducted between 2015 and 2017 in the Department of Orthopaedics, K.R Hospital, Mysore. Our sample size included 20 patients operated with Open reduction and internal fixation with locking compression plates and 20 patients operated with closed reduction and internal fixation with intramedullary nails. Inclusion criteria was all patients aged between 18 and 65 years, with closed fractures of the middle third of humerus

and having sustained the fracture less than 2 weeks before surgery. Patients aged below 18 years and above 65 years, those with pathological fractures, and patients with neurovascular injuries at the time of presentation were excluded from the study. Open reduction and internal fixation with locking compression plate was done using the posterior approach in all the 20 patients in the group.

All the 20 patients in the intramedullary nailing group were operated by closed reduction and internal fixation with anterograde insertion of interlocking humerus nail.

Post-operatively all the patients were given an arm pouch and encouraged to perform only elbow flexion and extension exercises. After 3 weeks, patients were taught to perform

pendulum exercises and the goal was to achieve full range of movements by 8 to 12 weeks, but avoiding active external rotation beyond 40 degrees and forward flexion beyond 90 degrees. Between 6 to 12 weeks, progression of range of movements from closed chain to open chain was done. After 12 weeks, strengthening exercises were advised to the patients in the form of light weights and band exercises.

The disabilities, complications and range of movements were recorded and tabulated at a minimum of 1 year following surgery by the Rodriguez–Merchan scoring system <sup>[4]</sup>. The subjective outcome was measured by the DASH (disability of arm shoulder and hand) questionnaire <sup>[5]</sup>.

Outcome	Elbow range of movements	Shoulder range of movements	Pain	Disability
Excellent	Extension 5 degrees, Flexion 130 degrees	Full range of movements	None	None
Good	Extension 15 degrees, Flexion 120 degrees	<10% average loss of movements	Occasional	Minimal
Fair	Extension 30 degrees, Flexion 110 degrees	10-30% average loss of movements	With activity	Moderate
Poor	Extension 40 degrees, Flexion 90 degrees	>30% average loss of movements	Variable	Severe

## Results

The demographic data of the two groups was compared and no statistically significant difference was found between them in the below mentioned characteristics.

Characteristics	Intramedullary Nailing group	Plating group
Males : Females ratio	11 : 9	13 : 7
Average age (range)	55.1 (21 – 63)	46.9 (22 – 60)
Mode of injury :		
RTA	40% (8)	50% (10)
Fall from height	20% (4)	10% (2)
Sports injuries	15% (3)	15% (3)
Others	25% (5)	25% (5)
Fracture classification:		
AO type A	40% (8)	35% (7)
AO type B	35% (7)	35% (7)
AO type C	25% (5)	30% (6)

The patients were comparable at baseline as described above. The final outcome of the patients was recorded and tabulated after a minimum of 1 year following surgery. They were evaluated based on pain, the range of movements at the elbow and shoulder and the disability of the patient based on the DASH scoring system.

Characteristics	Intramedullary Nailing group	Plating group
Outcome at 1 year (Rodrigues-Merchan)		
(a) Excellent	2(10%)	7(35%)
(b) Good	3(15%)	7(35%)
(c) Fair	8(40%)	4(20%)
(d) Poor	7(35%)	2(10%)
Shoulder stiffness	9(45%)	2(10%)
Average DASH score (SD)	37.8(4.2)	20.1(3.8)
Complications :		
Radial Nerve injury	None	1
Axillary nerve injury	4	None
Superficial wound infection	None	2
Deep wound infection	None	1
Delayed union	1	1
Non-union	None	None
Implant failure	1	2

Axillary nerve injuries were noted in 4 out of the 20 patients in the nailing group. The neurological deficits recovered completely in all patients with physiotherapy alone.

Radial nerve palsy was note in 1 patient in the plating group after surgery. The palsy recovered completely within 3 months.

2 cases of superficial wound infection were recorded in the plating group and were treated with oral antibiotics and regular dressing.

1 case of deep wound infection was seen in the plating group which was managed by debridement and antibiotics.

1 patient in each group were found to have delayed union. They were closely followed up and their fractures eventually united.

A significantly higher incidence of shoulder stiffness was recorded in the intramedullary nailing group. It was managed by physiotherapy and analgesics, but a residual stiffness still remained.

A significant difference in the DASH score was recorded, in favour of the plating group. This could be attributed to the pain free movements at shoulder joint.

A significant difference in the Rodrigues Merchan outcome was seen, in favour of the plating group, with 70% patients having achieved good to excellent outcome, as opposed to 25% in the nailing group. A higher incidence of poor outcomes was seen in the nailing group due to shoulder related complications.

## Discussion

Shaft humerus fractures are unique because even with 3cm of shortening, 30 degrees of rotation and 20 degrees of angulation after fracture union, functionality of the limb is maintained <sup>[6]</sup>. Open reduction and internal fixation with plate and screws of these fractures is the gold standard and is reported by multiple studies to give an excellent outcome. The increased blood loss and operative complications like radial nerve palsy, superficial infections and deep infections have motivated surgeons to look for other alternative surgical techniques to treat and fix these fractures. Closed reduction and internal fixation with intramedullary nails have been studied extensively by a meta-analysis by Ouyang et.al<sup>[7]</sup>. According to their meta-analysis, nailing of humerus shaft fractures leads to a high incidence of shoulder related complications and that further effects the final outcome of patients in the long term.

Multiple studies have been done to evaluate intramedullary nails and locking compression plates in the management of shaft humerus fractures. Madey et.al studied locking plates in treating shaft humerus fractures and recorded an average DASH score of 13 at the end of 24 weeks [8]. Our study had a similar average DASH score of 20.1 in the plating group. Their study showed a incidence of 9% of implant failure, and we detected a 10% rate of implant failure in the plating group, which could be due to the early unsupervised weight lifting by the patients. Singiseti *et al.* compared intramedullary nails and compression plates in treating shaft humerus fractures, using Rodriguez-Merchan criteria [9]. They had 65% excellent to good results in the intramedullary nail group as compared to our study where we had 25%. In the plating group, they showed 95% excellent to good results compared to our study in which we had 70%. This could probably be explained by the longer period of follow up of patients in their study, and none of their patients had sustained an AO Type C fracture, as compared to ours where 11 patients were AO Type C. Their study showed a 6.25% incidence of radial nerve injury in the plating group, which was similar to our incidence of 5%. We detected no infection in the nailing group and 15% of patients in the plating group developed either superficial or deep infections. Similar findings were recorded in the study by Singiseti *et al.* Their study recorded 15% patients in the nailing group developing shoulder related complications. Our study had a higher incidence of 45% of shoulder stiffness, which ultimately led to a higher incidence of poor outcome in the nailing group.

**Conclusion**

From our study we concluded that Open reduction and internal fixation with locking compression plates gave a better outcome to patients when followed up after surgery as compared to Closed reduction and internal fixation with interlocking nails. Despite having the disadvantage of

perioperative complications in the plating group like infections and radial nerve palsy, patients in the plating group fared better than those in the nailing group, many of whom had lasting shoulder related complications.



**Fig 1:** Pre-operative Xray showing mid-shaft humerus fracture



**Fig 2:** Post-operative xray at 4 months showing complete union of the fracture



**Fig 3:** Shoulder range of movements on follow u



**Fig 4:** Pre-operative and post-operative xrays



**Fig 5:** Follow up xrays showing union



**Fig 6:** Forward flexion of shoulder and flexion at elbow



**Fig 7:** Abduction



**Fig 8:** Abduction and external rotation

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