

Original Research Article

Comparative study of operative management of humeral shaft fractures by dynamic compression plating versus locked intra-medullary nailing

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ABSTRACT

Background: Operative management of humeral shaft fractures is mostly accomplished by surface plating or intra-medullary nail osteosynthesis. Both the treatment options have been variably reported to give good rates of union and functional outcome. We compared both the options to know the better one in multitude of variables.

Methods: Thirty patients with fracture shaft of humerus were followed up for a period of 12 to 18 months. 15 patients each underwent open reduction and internal fixation with dynamic compression plate and closed antegrade locked intra-medullary nailing. All patients were clinically and radiologically assessed till fracture union.

Results: Diaphyseal humeral fractures in all the patients treated with nailing united and had a tendency to unite early compared to plating. Shoulder pain was initially complained by 2 patients from the nailing group and got subsided later on. The incidence of complications was more in the plate osteosynthesis group.

Conclusions: In our study Intra-medullary nailing turned out to be superior to plating for amenable diaphyseal fractures of humerus in terms of higher rate of union, early union and lesser complications.

Keywords: Humeral shaft fracture, Plate osteosynthesis, Intra-medullary nailing, Fracture union

INTRODUCTION

Humeral shaft fractures account for about 3% to 5% of all fractures.^{1,2} Most of them can be managed non-operatively.^{3,4} General accepted non operative treatment protocol of humeral shaft fractures includes 7 -10 days of sling and swathe, U-slab or hanging cast followed by functional bracing till fracture union. Non operative management often has good functional results, but prolonged immobilization, malunion, delay in return to pre-injury activities, shoulder and elbow stiffness are a matter of concern.⁵

In light of patients demand for faster union and earlier return to pre-injury status, preserving functionality and motion of nearby joints, operative intervention of diaphyseal humeral fractures underwent significant advances in the last few decades. Current indications of operative intervention for humeral shaft fractures are open and segmental fractures, pathological fractures, bilateral fractures, floating elbow injuries, polytrauma and cases of associated vascular injury.^{1,6}

Open reduction and internal fixation with plates and screws continues to be the prime modality in operative treatment of diaphyseal humerus fractures.³ Plate

osteosynthesis provides direct fracture visualization, allows anatomical reduction and rigid fracture fixation. It is reported to achieve high rates of union and good functional outcome. Extensive soft tissue stripping and dissection can lead to delayed union, nonunion, iatrogenic radial nerve palsy and increased chances of infection.⁷

Intra-medullary nails used for humeral shaft fractures can be flexible or rigid locked nails. Nails can be inserted antegrade through the proximal humerus or retrograde through the distal humerus. Antegrade locked nailing is most commonly used for intra-medullary nail fixation of humeral shaft fractures in adults. Closed intra-medullary nailing is minimally invasive, preserves soft tissues at the fracture site (biological fixation), has high rates of early union and has lesser blood loss.^{8,9} Locked nailing provides rotationally stable fixation and allows early mobilization. Shoulder pain due to violation of rotator cuff, nonunion due to distraction at fracture site owing to incarceration of mismatched nail in distal fragment and iatrogenic neurovascular injury during distal locking are known complications of antegrade nailing.¹⁰

Comparative studies of plate osteosynthesis versus intra-medullary nailing in fractures of shaft of humerus have reported contradictory conclusions.^{1,3,4,6,8,11,12} The purpose of this study was to compare nailing and plating in humeral shaft fractures with regard to union rate, time taken for fracture union, functional outcome and incidence of complications.

METHODS

This is a prospective comparative study done from November 2011 to July 2013 in the department of Orthopaedics, MediCiti Institute of Medical Sciences, Ghanpur, Medchal, Rangareddy District, Telangana, of radiological union and functional outcome of 30 patients of fracture shaft of humerus treated with open reduction and dynamic compression plating in 15 patients and closed reduction, antegrade locked intra-medullary nailing in 15 patients. A randomization attempt was made by allocating each patient to either of the groups depending on the criteria of odd or even patient identification number issued by the Hospital sequentially. The inclusion criteria were age between 18 to 60 years; closed diaphyseal fractures. The exclusion criteria were fractures within 5 cm of proximal and distal end humerus; pathological fractures.

All patients were assessed clinically and radiologically before operative intervention was advised. All fractures were classified according to the AO classification. Pre-anesthetic checkup was done and patients were optimized before surgery.

All patients were operated under general anesthesia. Anterolateral approach with patient in supine position was used for 8 patients of plating, while posterior approach with patient in lateral position was used for 7

patients. During plating, minimal soft tissue dissection, periosteal stripping as required was done and iatrogenic radial nerve injury was prevented by careful retraction and dissection near the nerve. A 4.5 mm dynamic compression plate was used in all patients. Six to eight cortices as permissible were engaged on either side of the fracture. Inter-fragmentary lag screw fixation was used when required.

Antegrade locked intra-medullary nailing was done with patients in supine position. A 2 to 3 cm anterolateral incision was given from anterolateral edge of acromion obliquely. Deltoid muscle was split in line with the fibres longitudinally and rotator cuff was incised in the direction of fibers of supraspinatus. Entry point was made with bone awl and checked under image intensifier. Guide wire was passed across fracture site after reduction under fluoroscopy control and medullary canal was reamed in 0.5 cm increments. Intramedullary nail was passed and locked proximally and distally with 1 or 2 screws each. Rotator cuff incision was sutured and wound was closed in layers.

Postoperatively, operated upper limb was placed in arm sling pouch and intermittent active shoulder and elbow exercises were initiated as early as permissible by the patient. After suture removal, immobilization was discontinued and full range of motion exercises was started. Patients were followed up with clinical and radiological assessment on monthly basis until fracture union was documented.

The results were analyzed using the unpaired t test and the difference in mean union time between the two groups was also compared. P value of <0.05 was taken to be statistically significant.

RESULTS

Of the 30 patients treated in our series, the youngest one was 18 years old and the oldest one was 60 years old (Table 1). The commonest age group affected was 18 to 27 years (26.67%). Male patients (86.67%) were more in number than female patients. No obvious side predilection was noted. Majority of fractures (70%) were due to motor vehicular accidents followed by fall from a height (20%). Fractures in the region of the middle 1/3rd of the shaft of the humerus were more common (56.67%). Common fracture types were: AO 12-A3 (simple transverse fracture) 26.67%, AO 12-A2 (simple oblique fracture) 20%. All the other remaining cases were of other fracture types.

Majority of patients (80%) treated with open reduction and dynamic compression plating had radiological union within 16 weeks. The average time of union was 12 weeks. All the patients treated with antegrade locked intra-medullary nailing had radiological union within 16 weeks. The average time of union was 10.7 weeks inspite of the mean age and female preponderance in the nailing group being higher than the plating group (Table 2).

Shoulder and elbow joint function was assessed using ASES (American shoulder and elbow surgeons) score. Average ASES scores of plate osteosynthesis was 85.3

(range 68-95) and that of locked nailing group was 79.8 (range 66-96).

Table 1: Clinical details of patients and fracture classification.

	Plating group (%)	Nailing group (%)	Total (%)
Age (years)			
Mean	35.67	40.27	37.97
Range	18-60	22-60	18-60
Sex			
Male	14 (93.33)	12 (80)	26 (86.67)
Female	1 (6.67)	3 (20)	4 (13.33)
Mechanism of injury			
Road traffic accident	11 (73.34)	10 (66.67)	21 (70)
Fall	2 (13.33)	4 (26.67)	6 (20)
Assault	2 (13.33)	1 (6.66)	3 (10)
Fracture position			
Upper 1/3	-	4 (26.67)	4 (13.33)
Upper-middle 1/3	1 (6.67)	-	1 (3.33)
Middle 1/3	8 (53.33)	9 (60)	17 (56.67)
Middle-lower 1/3	6 (40)	1 (6.67)	7 (23.33)
Segmental	-	1 (6.67)	1 (3.33)
AO subtype			
12-A1	3 (20)	1 (6.67)	4 (13.33)
12-A2	4 (26.67)	2 (13.33)	6 (20)
12-A3	5 (33.33)	3 (20)	8 (26.67)
12-B1	-	2 (13.33)	2 (6.67)
12-B2	3 (20)	2 (13.33)	5 (16.67)
12-B3	-	1 (6.67)	1 (3.33)
12-C1	-	3 (20)	3 (10)
12-C2	-	1 (6.67)	1 (3.33)

Table 2: Results.

	Plating group	Nailing group
Rate of union (%)	86.67	100
Time of union (in weeks)		
Average	12	10.7
Range	8-20	8-16
ASES score		
Average	85.3	79.8
Range	68-95	66-96

Table 3: Complications.

	Plating group (%)	Nailing group (%)
Superficial infection	0	1 (6.67)
Deep infection	1 (6.67)	0
Delayed union	1 (6.67)	0
Nonunion	2 (13.33)	0
Iatrogenic radial nerve palsy	2 (13.33)	0
Elbow stiffness	1 (6.67)	0
Shoulder stiffness	0	2 (13.33)
Total	7 (46.67)	3 (20)

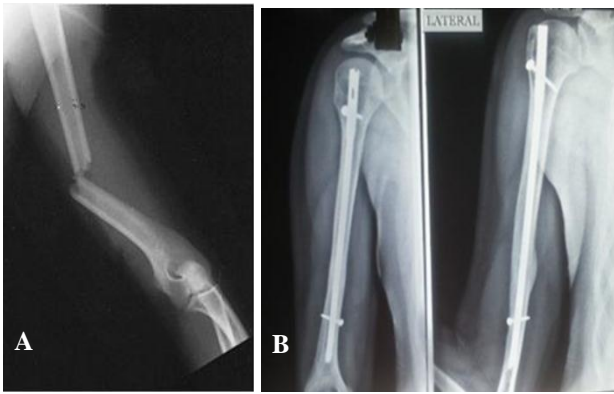


Figure 1: (A) Preoperative radiograph showing fracture shaft of humerus, (B) Postoperative radiographs showing antegrade intra-medullary locked nail with secondary bone healing.

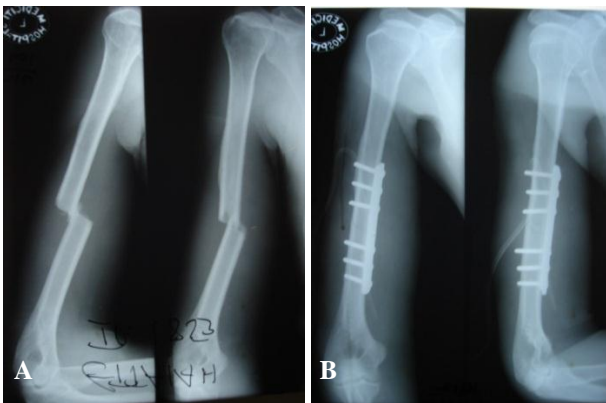


Figure 2: (A) Preoperative radiograph showing fracture shaft of humerus, (B) Postoperative radiograph showing internal fixation with dynamic compression plate.



Figure 3: Clinical photograph depicting functional outcome of patient treated with antegrade intra-medullary locked nailing.

There was one case of deep infection (6.67%), delayed union (6.67%), two cases of nonunion (13.33%), iatrogenic radial nerve palsy (13.33%) and one case of Elbow stiffness (6.67%) in the plate osteosynthesis group (Table 3). There was one case of superficial infection

(6.67%) and two cases of shoulder pain and stiffness (13.33%) in the locked nailing group which subsided later on with physiotherapy.

DISCUSSION

In the present study, humeral shaft fractures treated with antegrade locked intra-medullary nailing had higher rate of union (Figure 1) and earlier union than those treated with plate osteosynthesis (Figure 2), which was statistically significant ($p=0.02$). The functional outcome between both the groups was comparable with insignificant statistical difference. Plating group had more number of complications.

Closed antegrade locked intra-medullary nailing preserved the fracture hematoma, periosteum and soft tissues around the fracture leading to biological fixation. Maximum possible bone to bone contact was achieved and distraction was avoided in all cases, this has contributed to the higher rate of union and earlier union.

In all the cases of interlocking nailing, rotator cuff incision was given medially near musculotendinous junction in line with supraspinatus fibers for better healing and less postoperative pain. Reamer head was passed into humeral head before starting the actual reaming to prevent injury to supraspinatus tendon. Nail was countersunk by 5 mm from bone margin. Before closure thorough wound irrigation was given to remove reamed debris. Postoperatively, all the patients received tailored physical therapy. All the above measures in each case have led to decreased shoulder pain and good functional outcome in nailing group (Figure 3).

Fan et al have concluded that the interlocking nailing was a better surgical option than plating.⁴ We also report interlocking nailing is superior to plating as nailing has higher rate of union and earlier union with lower incidence of complications in comparison to the conventional plate osteosynthesis for diaphyseal fractures of humerus. Various studies have reported different outcomes. Some studies have reported plating to be superior than nailing.^{1,3,6} Meta-analysis of studies have reported no significant difference in outcomes between plating and nailing.^{11,12} In osteoporotic fractures, nailing is effective than plating as it allows early mobilization.³ Nailing is preferred than plating in segmental fractures, pathological fractures, for fractures in obese patients, and for fractures in patients with polytrauma.¹³

To conclude, in a properly selected and executed case, antegrade locked intra-medullary nailing scores over the plate osteosynthesis of humeral shaft fractures with respect to higher rates of union and early union with no significant difference in functional outcome. In our study, the incidence of complications was less in nailing group.

We recommend few guidelines for predictable and favorable outcomes in nailing. Upper and middle third

shaft fractures are ideal for nailing. Always select proper sized nail both in length and width. Longer and broader nails end up in distraction at the fracture site. Rotator cuff should be incised in line of its fibers medially at musculotendinous junction for better healing and less shoulder pain. Always align the fracture fragments prior to reaming the proximal fragment to avoid angulation at fracture site. Attain maximum possible native bone to bone contact before interlocking bolts are fixed. Sink the proximal end of nail at least 5 mm below articular margin before locking the nail to avoid shoulder impingement. Optimally expose till the surface of the bone before drilling and insertion of interlocking bolts to avoid neurovascular injury. Give thorough wound lavage to clear reamed material from proximal shoulder wound and suture rotator cuff meticulously to prevent shoulder problems. Mobilize early to ensure full range of motion at shoulder.

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