

Treatment of Fracture of Shaft of Humerus using Dynamic Compression Plating versus Interlock Nailing: Comparative Study

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Abstract:

Aim: The aim of the present study was to assess the management with interlocked nail in treatment of acute fracture shaft humerus and to compare its effectiveness with well-established method of plate fixation.

Methods: The present study of management of acute humeral shaft fractures by antegrade interlocking nail fixation and dynamic compression plating was undertaken in the Department of Orthopaedics. The average follow-up period was one year (range 10–24 months). 100 patients were included in the study.

Results: There was preponderance of male over female with majority population in 31-40 years age group. The youngest patient was of 28 years and oldest was of 65 years male. Mean age was 38.62 years. In our study, majority of cases were of road traffic accident (85%) followed by history of fall from height (10%) and only 4 cases of assault. Middle third shaft fractures were more common (53%) followed by lower and upper third respectively. Transverse fractures were maximum in number (45%) followed by oblique (29%). There were 13 spiral and 13 comminuted fractures. There were 75 (75%) close fractures and 25 (25%) open fractures. There were 25 cases (25%) of preoperative radial nerve palsy. Out of 25 cases, 23 had recovered completely. There was no iatrogenic nerve palsy seen in our study. Out of 25 cases explored nerve was found to be intact in 23 cases and contused in 2 cases. Most of cases (16) of radial nerve palsy were associated with fracture of middle third shaft humerus.

Conclusion: For patients requiring surgical treatment of humeral shaft fractures, both dynamic compression plating and interlock nailing provide predictable methods for achieving fracture stabilization and ultimate healing. Plating requires extensive dissection, more blood loss and duration of surgery as compared to nailing. Antegrade interlock nailing performed properly is safe, effective and quick method.

Keywords: Humerus shaft fracture, interlocking nailing, dynamic compression plating, management

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Introduction

Humeral shaft fractures are commonly seen among individuals. It comprised of 3%- 5% of all bony fractures. Most of orthopaedic surgeons come across cases of humeral shaft fractures. It has bimodal age distribution. It is mostly seen among young patients with high-energy trauma and in case of elderly it is usually seen among osteopenic patients with low energy injuries. [1] Patients experience severe pain and extremity weakness. Humeral shaft fractures are the result of direct and indirect trauma. Though it is usually seen with direct trauma, but indirect forces such as fall on outstretched hand or elbow are also common causes of shaft humerus fracture. [2] OTA classification of humerus shaft fracture includes

bone number, fracture location, fracture pattern such as simple, wedge and complex. Fracture location can be proximal, middle or distal third and fracture pattern may be spiral, transverse, comminuted or Holstein-Lewis fracture which is a spiral fracture of the distal one-third of the humeral shaft commonly associated with neuropraxia of the radial nerve. [3]

Management includes both conservative and non conservative modality. However, most humeral shaft fractures can be managed non-operatively exhibiting excellent results. [4] Earlier they were treated with the help of hanging casts, arm cylinders, collar and cuff slings, then functional cast bracing,

U casts, shoulder spica improved results but the long duration of treatment results in adverse effect on economy of the patients. Healing of the fracture site depends upon blood supply. [5] There can be various complications in conservative management such as non-union, malunion, limitation of joint motion and progressive degenerative arthritis. The superior results that have been observed with recent advances in internal fixation techniques and latest instrumentation have led to an expansion of surgical indications for such fractures. [6]

The techniques of interlock nailing represent a newer approach to treatment of humeral shaft fractures. These newer device have demonstrated fewer mechanical problems, malunion, infection, iatrogenic radial nerve palsy, less operative time and blood loss as shown by many studies done in past. [7-9] Various implant options are available for treating humeral diaphyseal fractures e.g. interlocking nails, dynamic compression plating, limited contact dynamic compression plating, flexible nails, locking plates. Compression plate fixation techniques as developed and refined by the AO/ASIF group. [10]

The aim of the present study was to assess the management with interlocked nail in treatment of acute fracture shaft humerus and to compare its effectiveness with well-established method of plate fixation.

Materials and Methods

The present study of management of acute humeral shaft fractures by antegrade interlocking nail fixation and dynamic compression plating was undertaken in the Department of Orthopaedics Narayan Medical College and Hospital, Sasaram, Bihar. The average follow-up period was one year (range 10–24 months). 100 patients were included in the study.

Forty-five patients with closed acute humeral shaft fracture requiring operative intervention were treated with either interlocking nailing or plating procedures. A randomisation attempt was made by allocating each patient to either of the groups

depending on the criteria of odd or even hospital number.

The inclusion criteria were: (1) humeral shaft fractures which required operative intervention and were treated with interlocking or plating procedures, and (2) patients of age of 18 years or more.

The exclusion criteria were: (1) the patient was aged less than 18 years, (2) pathological fractures, (3) segmental fractures, (iv) fractures within 4cm of proximal and distal end of humerus, and (5) patients who were lost to follow-up or at early stages of follow-up at the time of completion of the study (minimum follow up of six months required).

All patients had appropriate clinical and radiological assessment before a decision to offer surgical intervention was made. All fractures were classified according to the AO classification.

An antegrade interlocking technique was used with an intramedullary nail (Russell-Taylor type) and care was taken to minimise damage of the rotator cuff during nail insertion. A 3.5-mm or 4.5-mm dynamic compression plate was used in the plating group depending on the width of the bone with appropriate AO principles. The choice of surgical approach (antero-lateral or posterior) for the plating group was left to the discretion of the operating surgeon.

All patients were advised on immediate postoperative shoulder and elbow exercises and radiographs were taken at regular intervals during follow-up. Rodriguez-Merchan criteria (1995) were used to compare the postoperative results of interlocking nailing and plating procedures at follow-up. It was originally described for comparison of compression plating versus Hackethal nailing in closed humeral shaft fractures.¹¹ The overall rating of excellent, good, fair and poor outcomes was based on scores of shoulder and elbow movements along with pain and disability after the procedure. In situations where any two different criteria fell into separate categories, the lower category was selected to classify the outcome.

Results

Table 1: Age wise and Gender wise Distribution of Patients

Age in years	Gender		Total
	Male	Female	
<30	15	5	20
31-40	30	25	55
41-50	10	5	15
51-60	2	2	4
>60	3	3	6
Total	60	40	100

There was preponderance of male over female with majority population in 31-40 years age group. The youngest patient was of 28 years and oldest was of 65 years male. Mean age was 38.62 years.

Table 2: Distribution according to characteristics of fracture

Mechanism of injury	N	%
Road Traffic Accident	85	85
Fall From Height	10	10
Assault	5	5
Anatomical Level of Fracture Shaft		
Upper third	23	23
Middle third	53	53
Lower third	24	24
Type of Fracture		
Transverse	45	45
Oblique	29	29
Spiral	13	13
Comminuted	13	13
Type of fracture		
Open	25	25
Close	75	75

In our study, majority of cases were of road traffic accident (85%) followed by history of fall from height (10%) and only 4 cases of assault. Middle third shaft fractures were more common (53%) followed by lower and upper third respectively. Transverse fractures were maximum in number (45%) followed by oblique (29%). There were 13 spiral and 13 comminuted fractures. There were 75 (75%) close fractures and 25 (25%) open fractures.

Table 3: Distribution According to Radial Nerve Injury and Intervention

Radial nerve palsy and recovery (N=25)	N	%
Pre-operative	25	100
Post-operative	0	0
Radial Nerve Palsy Recovery		
Recovered	23	92
Not recovered	2	8
Condition of Radial Nerve on Exploration		
Intact	22	88
Contused	3	12
Lacerated	0	0
Site of Fracture Shaft Presented with Radial Nerve Palsy		
Upper third	0	0
Middle third	16	64
Lower third	9	36

There were 25 cases (25%) of preoperative radial nerve palsy. Out of 25 cases, 23 had recovered completely. There was no iatrogenic nerve palsy seen in our study. Out of 25 cases explored nerve was found to be intact in 23 cases and contused in 2 cases. Most of cases (16) of radial nerve palsy were

associated with fracture of middle third shaft humerus. Majority of cases of fracture shaft humerus were associated with head injury followed by lower extremity fracture and ipsilateral forearm bone fracture.

Table 4: Distribution According to Approach for Surgery of fracture

Operative Procedure	Fracture	Anterior Approach	Posterior Approach	Total
Dynamic Compression Plating		35	15	50
Interlock Nailing	Close	40	0	50
	Open	10	0	

Anterolateral approach was used in 35 patients with dynamic compression plating. Posterior approach was used in 15 cases of lower third shaft fracture. Close interlock nailing was performed in 40 patients and open nailing by anterior approach in 10 patients.

Table 5: Distribution According to Radiological Union Time of Fracture

Period	Interlock Nail		Dynamic Compression Plate	
	N	%	N	%
<17 weeks	35	70	31	62
<26 weeks	10	20	13	26
<30 weeks	0	0	5	10
No union	5	10	1	2
Total	50	100	50	100

Majority of fractures in nailing and plating group were united within 17 week respectively. There was 5 non-union in plating as compared to one in nailing group. There was highly significant difference between mean values of duration of surgery in nailing and plating group ($p<0.01$).

Discussion

Most of humerus diaphyseal fractures heal with appropriate care, although a small but consistent number will require surgery for optimal outcome, which is usually suitable, to isolated fractures. [12] Most of the early methods of treatment focused primarily on comfort and patient mobilization. The simplest method involved binding the extremity to the patient's body with Sling and Swathe device. Although this did provide comfort and promote union, alignment was poorly controlled. The hanging arm cast, introduced later, achieved better alignment. This method relied not only on a direct splinting effect from plaster but on gravity to overcome the deforming forces. Using rigid plastic orthosis with adjustable straps popularized as functional cast bracing by Sarmiento has given excellent clinical and radiological outcome in fracture humerus. [13-15] Although complications are infrequent, nonoperative treatment requires a long period of immobilization, which carries a risk of prolonged shoulder stiffness and may be inconvenient to patient. [16,17]

There was preponderance of male over female with majority population in 31-40 years age group. The youngest patient was of 28 years and oldest was of 65 years male. Mean age was 38.62 years. These findings were comparable with previous studies. [18,19] In our study, majority of cases were of road traffic accident (84%) followed by history of fall from height (12%) and only two cases of assault. Middle third shaft fractures were more common (52%) followed by lower and upper third (26% and 22%) respectively. Transverse fractures were maximum in number (46%) followed by oblique (30%). There were 6 spiral and 6 comminuted fractures. There were 38 (76%) close fractures and 12 (24%) open fractures. Our findings also co-relate with previous studies. [18,20]

The indications for open reduction and internal fixation of acute fractures of the humeral shaft have been described as open fractures, fractures

associated with vascular or neural injuries or with lesions of the shoulder, elbow or forearm in the same limb; bilateral upper extremity injuries, fractures for which closed methods of treatment have failed and pathological fractures, fractures in patients with multiple injuries. [21-24] In several reported series, the presence of associated multiple injuries was the most frequent indication for internal fixation of the humeral shaft. [21,22,24] Habernek and Orthner [25] in 1991 reported good results with Seidel's interlocking nail but later withdrew their support in 1998, as they had assessed the shoulder functions of their patients properly because of disruption of the rotator cuff in its avascular zone within of its insertion to the greater tuberosity that may lead to poor healing. [26] There were 25 cases (25%) of preoperative radial nerve palsy. Out of 25 cases, 23 had recovered completely. There was no iatrogenic nerve palsy seen in our study. Out of 25 cases explored nerve was found to be intact in 23 cases and contused in 2 cases. Most of cases (16) of radial nerve palsy were associated with fracture of middle third shaft humerus. Majority of cases of fracture shaft humerus were associated with head injury followed by lower extremity fracture and ipsilateral forearm bone fracture. Anterolateral approach was used in 35 patients with dynamic compression plating. Posterior approach was used in 15 cases of lower third shaft fracture. Close interlock nailing was performed in 40 patients and open nailing by anterior approach in 10 patients. Majority of fractures in nailing and plating group were united within 17 week respectively. There was 5 non-union in plating as compared to one in nailing group. There was highly significant difference between mean values of duration of surgery in nailing and plating group ($p<0.01$).

Conclusion

For patients requiring surgical treatment of humeral shaft fractures, both dynamic compression plating and interlock nailing provide predictable methods for achieving fracture stabilization and ultimate healing. Plating requires extensive dissection, more blood loss and duration of surgery as compared to nailing. Antegrade interlock nailing performed properly is safe, effective and quick method. Interlock nailing is more suitable for cases of osteoporotic fractures, comminuted fractures in which plating is not preferable. In cases of fracture

shaft humerus with associated radial nerve palsy if anatomical reduction is not possible, exploration of the nerve and fixation is required.

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