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To Study Functional Outcome of Humeral Shaft Fractures Treated by Intramedullary Nailing Versus Dynamic Compression Plating at a Tertiary Health Care Centre

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Abstract

Background: The proportion of humeral shaft fractures being treated conservatively reportedly varies from 33% to 95%. Nonsurgical treatment results in higher incidence of union and fewer complications than open reduction and internal fixation. **Aims and Objectives:** To study and compare the functional outcome of Dynamic Compression Plating and Interlock Nailing for humeral shaft fractures. M**aterial and Methods:** After taking approval of ethics committee of our institute, we studied a total of sixty cases over a span of 36 months – October 2018 to December 2020. Study was carried out on cases of humeral shaft fractures requiring operational intervention in department of orthopaedics of tertiary care centre in Maharashtra. **Results:** A total of 76.7% cases in plating group had excellent outcome as compared to 56.7% in nailing group. Also poor to fair outcome was noted more in nailing group (13.4% vs 10%). **Conclusion:** Statistically comparable results have been observed for patients undergoing surgical intervention for humeral shaft fractures among locking plating and intramedullary nailing. Both provide excellent and favourable results in terms of union and function, however a higher rate of excellent results and tendency for union was seen with dynamic compression plating group.

Keywords: Dynamic Compression Plating, Humeral Shaft Fracture, Intramedullary Nailing, Open Reduction Internal Fixation

1. Introduction

The humeral shaft extends from the lower edge of the pectoralis major insertion to the supracondylar ridge of the distal humerus[1]. The fracture which occurs in this space is called humeral shaft fracture and consists of about 3% of all the fractures[2]. The causes in younger patients are commonly represented by high-energy trauma (car accident or sports injury), while in older patients by lower energy trauma (such as an accidental fall) but they are often associated with osteoporosis[3].

The proportion of these fractures being treated conservatively reportedly varies from 33% to 95%[4]. Intramedullary fixation of humeral diaphyseal fractures as well as compression plating or external fixation in open fractures is described[5].

Nonsurgical treatment results in higher incidence of union and fewer complications than open reduction and internal fixation. Though most heal well with conservative care, a small but consistent number will require surgery for optimum outcome. There are specific indications where operative treatment has been shown to improve the outcome of the fracture or the patient[5].

The purpose of this study is to compare the outcomes of each method of fixation (dynamic compression plating and interlocking nailing) for the fracture shaft of humerus

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and to know if there is any statistically significant difference in the results of these two methods.

2. Aims and Objectives

To study and compare the functional outcome of Dynamic Compression Plating and Interlock Nailing for humeral shaft fractures.

3. Materials and Methods

3.1 Study Area

Department of Orthopaedics, of a tertiary health care centre.

3.2 Study Population

All the patients with fracture shaft humerus coming to our hospital and giving informed consent.

3.3 Study Design

A Prospective observational study

3.4 Sample Size Calculation:

A total of 60 cases of fracture shaft humerus were prospectively randomized into two categories: **Group A**- Plating (open reduction and internal fixation with dynamic compression plating). **Group B**- Nailing (closed reduction and internal fixation with antegrade intramedullary interlocking nail).

3.5 Study Duration

October 2018–Dec 2020

3.6 Inclusion Criteria

- Either gender with age of >18 years
- Types of Humeral Shaft Fractures as per the Garnavos Classification.
- Fresh Fractures.
- Patients giving informed consent to participate in the study.

3.7 Exclusion Criteria

- Fracture of epiphyseal and metaphyseal region of humerus.
- Pathological fractures (Inflammatory Disorders, Infection, Inherited Disorders, Cancer, etc.).
- Open fractures.
- Patients treated conservatively for other medical reasons.
- Patients who were lost to follow up or died before the fracture union.
- Paediatric fractures [before physeal closure]

3. Methodology

All patients with fractures of shaft of humerus that met the criteria for operative interventions (intramedullary interlocking nailing and dynamic compression plating) presenting to the department of Orthopaedics in the study period and giving informed consent were included in the study. All patients had appropriate clinical and radiological assessment before a decision to offer surgical intervention was made. This was followed by routine preoperative investigations. The fractures were classified according to Garnavos classification of humeral shaft fractures[6]. All the patients were operated at an average interval of 7 days from the date of trauma.

Operative Technique: Patients were operated under general anaesthesia or brachial plexus block. An antegrade interlocking technique was used during intramedullary nailing and care was taken to minimize damage of the rotator cuff during nail insertion. Plating of mid shaft humeral fractures through anterolateral approach and posterior approach was done, reflecting the biceps medially in the former whereas triceps splitting in latter with minimum soft tissue dissection and periosteal stripping and with utmost care for radial nerve, especially at spiral groove. Before plate fixation we routinely checked for radial nerve impingement by plate ends.

Post operatively the patients were put on Intravenous Antibiotics and analgesics. The Operated limb was immobilised for initial 48 hours by elevating over pillow. Sutures were removed on 12th postoperative day and full range of motion was allowed for patients gradually. Patients were discharged with arm pouch. For patients undergoing nailing, were given humerus U-slab in the post-operative period and elbow immobilisation slab with slab was started from the 3rd or 4th post-operative day. Sutures were removed on the 10th postoperative day and functional humerus bracing given. Patients were advised to follow up every four weeks till radiographic union

was seen. Radiographic Union was assessed when X-ray showed bone trabeculae or cortical bone crossing fracture site on at a least three surfaces on orthogonal radiograms. Functional Outcome in Patients was assessed using the "Disabilities of the Arm, Shoulder and Hand (DASH)" Questionnaire at nine months or at full recovery which ever was earlier. Patients were given physiotherapy in the form of strengthening exercises, static and dynamic along with shoulder pendulum exercise with the humerus braces

3.9 Statistical Analysis

The quantitative data was represented as their mean ± SD. Categorical and nominal data was expressed in percentage. The t-test was used for analysing quantitative data, or else non parametric data was analysed by Mann Whitney test and categorical data was analysed by using chi-square test. The significance threshold of p value was set at <0.05. All analysis was carried out by using SPSS software version 21.

4. Observations and Results

A total of 76.7% cases in plating group had excellent outcome as compared to 56.7% in nailing group using the Disabilities of the Arm, Shoulder and Hand (DASH) system. Also poor to fair outcome was noted more in nailing group (13.4% vs 10%) (Table 1, Figure 1 - 6).

Functional Outcome	Group		Total
	DCP	IMN	
Excellent	23	17	40
	76.7%	56.7%	66.7%
Good	4	9	13
	13.3%	30.0%	21.7%
Fair	2	2	4
	6.7%	6.7%	6.7%
Poor	1	2	3
	3.3%	6.7%	5.0%
Total	30	30	60
	100.0%	100.0%	100.0%
p- value - 0.37			

Table 1. Comparison of functional outcome between the study groups

5. Discussion

Most surgeons agree that intramedullary nailing is the best internal fixation for femoral and tibial shaft fractures, but there is no agreement about the ideal procedure

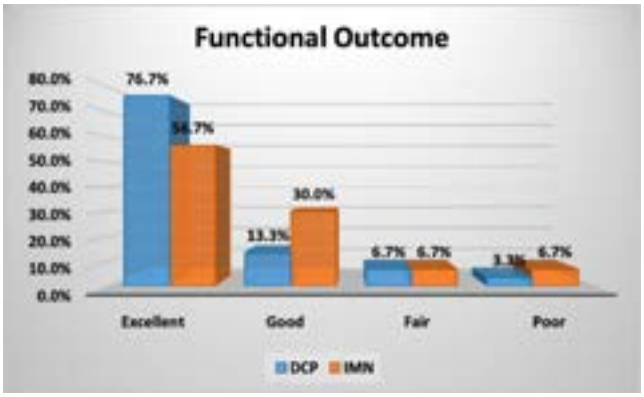

Figure 1. Showing a bar diagram of functional outcome between plating and nailing.

Figure 2. **Immediate post op X ray showing fixation achieved using DCP.**

Figure 3. Post op X ray at 3 months follow up.

for fractures of the humeral shaft. Many randomized controlled trials have reported Dynamic Compression Plate (DCP) fixation and interlocking nail fixation of

Figure 4. A patient's functional outcome at 3 months follow up.

Figure 5. Image showing mid shaft humerus fracture.

humeral shaft fractures. However, it is unclear whether one method is more effective than the other. Present hospital based comparative study thus aimed evaluate the functional outcome of Dynamic Compression Plating

Figure 6. Immediate post op X-ray of intramedullary nailing.

and Interlocking Nail done in cases of Humeral Shaft Fractures. A total of 60 cases of fracture shaft humerus were prospectively randomized into two categories: **Group A**- Plating (open reduction and internal fixation with dynamic compression plating) and; **Group B**- Nailing (closed reduction and internal fixation with antegrade intramedullary interlocking nail). Functional Outcome in Patients will be assessed using the "Disabilities of the Arm, Shoulder and Hand (DASH)" Questionnaire at nine months or at full recovery which ever was earlier.

5.1 Demography

Mean age of the cases in DCP (Dynamic Compression Plating) and IMN (Intramedullary Nailing) group was 40.13 years and 43.67years receptively with no difference between the groups (p-0.27). Out of the total 60 cases, 65% were females while 35% were males with no difference between the study groups (p-0.103). Joly A et al.,[9] in their study observed the mean age of cases as 45.3 and 49.5 years in nailing and plating group respectively with male

preponderance in both groups (55% vs 45). Gude N et al.,[11] in their study observed mean age of cases being 37.28 years with 71.1% males to 28.9% females. In the study by Saroj et al.,[12] age of the patients in the plating group ranged from 22 to 60 years with a mean of 37.28 years. The age in the interlocking group ranged from 23 to 70 years with a mean age of 35.05 years. In the plating group there were 13 males and 5 females. In the interlocking group, there were 14 males and 6 females. Rabari Y et al.,[13] in their study observed the mean age of patient treated with DCP (Dynamic Compression Plating) as 40.12 years and those treated with IMILN (Intra Medullary Interlock Nailing) as 41.96 years. Overall 81.1% cases were males and 18.9% were females. Partap Singh et al.,[8] observed the average age of patients as 35.77 years, with male female ratio 7:3.

5.2 Mode of Injury

Most common mode of injury for fracture shaft humerus was road traffic accidents (83.3%) followed by fall (13.3%). Most common mode of injury observed in the study by Joly A et al.[9] was RTA (47%) followed by fall from height (25%). Gude N et al.,[11] in their study observed Road traffic accident (RTA) was the most common mode of injury n = 27 (71.1%) cases followed by fall from height in n=7 (18.4%). Saroj et al.,[12] in their study also observed that most common mode of injury in both groups is RTA, with fall being the second most common cause. Similarly in the study by Rabari et al.,[13] RTA was the major mode of injury to shaft of humerus (84.9%) followed by falls (8%). Partap Singh et al.,[8] also observed that road side accident in 63.33% cases as common mode of injury.

5.3 Side and Site of Injury

Out of the 60 cases if fracture shaft humerus, 30% were in lower shaft, 55% were in middle while 15% were in upper shaft respectively. A total of 48.3% cases had left sided fracture while 51.7% had right sided fracture. Joly A et al.,[9] in their study observed that both sides were equally affected in fractures of shaft humerus with no predilection of any particular laterality. Mid shaft fractures were most commonly encountered in their study followed by lower shaft. Gude et al.,[11] in their study observed that right side was the most commonly involved in n = 23 (60.5%) compared to left side in n = 15 (39.5%). The most common site of fracture in both the groups was the middle third of the diaphysis (55.3%) followed by lower third (27.9%). In the study by Saroj et al.,[12] right side was the most commonly involved side in both the plating and interlocking group with no statistically significant difference. 21 fractures occurred in the middle third of the diaphysis, 9 fractures were there in lower third and 3 fractures in the upper third. Partap Singh et al.,[8] observed that fractures were more common on right side (63.33%) and in middle third region (53.33%).

5.4 Union Time

Radiological union was significantly faster in IMN (Intra Medullary Nailing) group as compared to DCP (Dynamic Compression Plating) group (14.33 vs 16.14 days; $p<0.05$). In the study by Jolly et al.,[10] Radiological union 14.6 weeks in nailing group while it was 15.7 weeks in plating group. In the study by Gude N et al.,[11] fracture union in the plating group was seen at 16 weeks and in the IMN (Intra Medullary Nailing) group 14 weeks. The average time taken for radiological union was 15 weeks and the range was 8-34 weeks. In the plating group, the average time taken for fracture union was 16.06 weeks (range 8-24 weeks), and in the IMN group, the average was 14.05 weeks (range 8-18 weeks). Average time taken for radiological healing in the study by Saroj et al.,[12] was 15.05 weeks (14.05 in interlocking group and 16.06 in plating group). Rabari et al.,[13] in their study also observed that mean radiological healing time in patient operated with DCP (Dynamic Compression Plating) was 14.42 weeks (SD±0.64) and in patient operated with IMLN (Intramedullary Interlock Nailing) was 13.35 weeks (SD±0.56). Thus, the healing rate was relatively faster in the interlocking group as compared to the plating group.

5.5 Functional Outcome

Mean DASH score was significantly lower in DCP group as compared to IMN group (17.10 vs 23.93; $p<0.05$), showing better functional outcome in plating group. A total of 76.7% cases in plating group had excellent outcome as compared to56.7% in nailing group. Also poor to fair outcome was noted more in nailing group (13.4% vs 10%). Joly A et al.,[9] in their study observed 90% cases managed by plating to have excellent or good functional outcome as compared to 80% cases in nailing group. Poor outcome was observed in 10% plating cases as compared to 16.7% nailing cases. Gude N et al.,[11] in their study observed that among the n = 10subjects with excellent results, n = 8 (44.44%) cases were of plating group and n = 2(10%) were interlocking nailing group. In the patients

treated by intramedullary nailing, n = 6 (30%) patients showed good results, n = 8(40%) patients showed fair results and n = 4 (20%) poor results. In patients treated by plate fixation, n = 6 (33.33%) cases showed good results, n = 2 (11.11%) fair and n = 2 (11.11%) cases showed poor results. In the study by Saroj et al.,[12] 77.8% cases of plating group had excellent to good outcome as compared 40% in nailing group while poor outcome was noted in 11.1% and 20% in plating and nailing group respectively. Rabari et al.,[13] observed excellent to good results in 80.7% cases of plating and only 48.1% cases of nailing while poor results were seen in 3.3% and 14.8% cases respectively. Ghosh S et al.,[7] observed excellent results in 22 patients (73.3%) in locking plate group and 18 patients (60%) in locking nail group. Partap Singh et al.,[8] observed that ILN shows 20% cases as excellent result and 46.67% cases showing satisfactory results and DCP patients showed 80% excellent results with 20% cases showing satisfactory results.

5.6 Complications

Overall complications rate was lower in plating group as compared to nailing group (16.7% vs 33.3%; p<0.27). Superficial infections were seen in 10% and 3.3%, stiffness in 10% and 6.7%, impingement in 6.7% and 0% while non –union was seen in 6.7% and 0% cases of nailing and plating group respectively. Implant failure was seen in 1 case of plating and none in nailing group. Ghosh S et al.,[7] studied 60 patients with closed acute humeral shaft fracture, out of 30 patients of plate group complications were: Infection-6.6%;delayed union-13.3%; shoulder movement restriction-13.3%; elbow movementrestriction-6.6%. Out of 30 patients of nail group complications were: Splintering of fracture end-6.6%; infection-6.6%; delayed union-26.6%; shoulder movement restriction-13.3%; elbow movement restriction-6.6%; shoulder pain-46.6%. Overall complication rate observe din the study by Joly A et al.,[9] was 40% in nailing group and 30% in plating group. Superficial infections were seen in 10% and 6.7% while non-union was seen in 6.7% and 3.3% cases of nailing and plating group respectively. Implant failure was seen in 6.7% case of nailing and 3.3% cases in nailing group. In the study by Gude N et al.,[11], 33.3% (6/18 cases) cases of plating group had some complications as compared to 65% (13/20 cases) in nailing group. Non-union was seen in 2 cases of plating group and none in nailing while implant failure was seen in 1 case each. Saroj et al.,[12] in their study observed that overall complications were more in the interlocking nailing group as compared to plating, which was statistically significant (p=0.009). Non-union in 2 cases of plating and none in nailing group. Rabari et al.,[13] observed non-union rates as 3.7% and 0% in plating and nailing group while infection rate as 3.3% and 10% respectively. Overall complication rate was higher in nailing group (p<0.05). Thus to summarize, both the methods of treatment (i.e., dynamic compression plating and interlocking nailing showed good functional outcome results. However plating offers better result with respect to better function of the shoulder joint. The overall complication rate was also less with plating as compared to nailing. We thus recommend dynamic compression plating as the preferred method to the interlocking nailing method for fracture shaft humerus.

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