

An Observational Study on the Functional Outcomes of Intramedullary Nailing Versus Dynamic Compression Plating for Humeral Shaft Fractures

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ABSTRACT

Objectives: The purpose of this research is to evaluate and contrast the functional results of Dynamic Compression Plating and Interlock Nailing for Humeral Shaft Fractures.

Material and Methods: The design of this study was a prospective observational study. This study was conducted in DHQ Teaching Hospital Gujranwala and the duration of this study was from October 2020 to December 2022. We evaluated a total of 60 cases after receiving ethics committee permission from our institute. In DHQ Teaching Hospital Gujranwala, a study on instances of humeral shaft fractures needing surgical intervention was conducted.

Results: In the plating group, 76.7% of the cases had outstanding results, compared to 56.7% in the nailing group. Moreover, the nailing group had a worse overall result (13.4% vs. 10%).

Conclusion: Locking plating and intramedullary nailing had statistically similar results for individuals undergoing surgical intervention for humeral shaft fractures. In terms of union and function, both provide excellent and favourable results, but the dynamic compression plating group had a higher percentage of positive results and a propensity for union.

Keywords: Humeral Shaft Fracture, Intramedullary Nailing, Dynamic Compression Plating

INTRODUCTION

The supracondylar ridge of the distal humerus is located at the end of the humeral shaft, which begins at the lower margin of the pectoralis major insertion⁽¹⁾. Humeral shaft fracture, which makes up roughly 3% of all fractures, is the fracture that happens in this area. Younger patients' causes are frequently high-energy trauma (car accidents or sports injuries), whereas older patients' causes are typically lower-energy trauma (such as an unintentional fall), although they are frequently linked to osteoporosis^(2,3). According to reports, 33% to 95% of these fractures are managed conservatively. Compression plating or external fixation in open fractures, as well as intramedullary fixation of humeral diaphyseal fractures, are reported⁽⁴⁾.

Compared to open reduction and internal fixation, nonsurgical therapy has a greater frequency of union and fewer problems. Even while the majority recover fully with conservative treatment, a tiny but steady percentage will have surgery for the best results⁽⁵⁾. Operative therapy has been demonstrated to enhance the patient's or the fracture's outcome in some circumstances. The goal of this study is to determine whether there is a statistically significant difference between the outcomes of these two fixing techniques (dynamic compression plating and interlocking nailing) for the fracture shaft of the humerus^(6,7).

Objectives: This study compared the clinical outcomes of dynamic compression plating with interlock nailing for humeral shaft fractures.

MATERIALS AND METHODS

Study Area: Department of Orthopedics of DHQ Teaching Hospital Gujranwala.

Study Population: Patients who come to hospital with a fractured shaft of the humerus gives their informed permission.

Study Design: A Prospective observational study

Sample Size Calculation: The following two groups were prospectively randomised from a total of 60 fracture shaft humerus cases: Group A: Plating (open reduction and internal fixation with dynamic compression plating). Ineffective in Group B (closed reduction and internal fixation with antegrade intramedullary interlocking nail).

Study Duration: October 2020–December 2022

Inclusion Criteria

- Anybody older than 18 years of any gender

- Humeral shaft fractures of various types according to the Garnavos classification.
- Recent fractures.
- Patients who provide their consent to engage in the study voluntarily.

Exclusion Criteria

- Epiphyseal and metaphyseal area of the humerus fracture.
- Degenerative fractures (Inflammatory Disorders, Infection, Inherited Disorders, Cancer, etc.).
- Open breaks.
- Individuals receiving conservative treatment for various medical conditions.
- Patients who were unreachable or passed away prior to the union of the fracture.
- Fractures in children (before to physeal closure)

Methodology: All patients with humeral shaft fractures who presented to the department of orthopaedics throughout the research period and provided written informed consent and satisfied the criteria for surgical procedures (intramedullary interlocking nailing and dynamic compression plating) were included in the study. Before the choice to give surgical intervention was made, all patients received the proper clinical and radiological examination. Preoperative routine investigations came next. According to Garnavos' categorization of humeral shaft fractures, the fractures were categorised. From the date of the event, each patient underwent surgery on average seven days apart.

Under general anaesthesia or brachial plexus block, patients were operated on. The rotator cuff was protected as much as possible during intramedullary nailing by using an antegrade interlocking approach. Placing of mid shaft humeral fractures by anterolateral approach and posterior approach was carried out with little soft tissue dissection, minimal periosteal stripping, and with the utmost care for the radial nerve, especially at spiral groove. In the former, the triceps were divided, but in the later, the biceps were medially reflected. Prior to fixing plates, we often checked for radial nerve impingement by plate ends.

The patients were given intravenous antibiotics and analgesics following surgery. During the first 48 hours, the operated limb was kept immobile by being elevated over a cushion. On the 12th postoperative day, the sutures were removed, and patients progressively gained complete range of motion. Armed with an arm pouch, patients were released. In the post-operative phase, patients who had nailing received humerus

U-slabs, and elbow immobilisation slabs with slabs were started on the third or fourth post-operative day. On the tenth postoperative day, the sutures were taken out and functional humerus bracing was applied. Following up with patients every four weeks until radiographic union was observed was indicated. When bone trabeculae or cortical bone crossed a fracture site on at least three surfaces on orthogonal radiograms, radiographic union was determined. At nine months or when the patient had fully recovered, whichever came first, the functional outcome of the patient was evaluated using the "Disabilities of the Arm, Shoulder and Hand (DASH)" Questionnaire. Patients received physiotherapy in the form of static and dynamic strengthening exercises, shoulder pendulum exercises, and humerus braces.

Statistical Analysis: The mean ± SD was used to depict the quantitative data. Nominal and categorical data were both reported as percentages. Quantitative data were analyzed using the t-test; non-parametric data were analyzed using the Mann Whitney test; and categorical data were analyzed using the chi-square test. The p value's significance cutoff was set at 0.05. SPSS software version 21 was used for all analysis.

RESULTS

Using the Disability of the Arm, Shoulder, and Hand (DASH) system, a total of 76.7% of patients in the plating group and 56.7% of cases in the nailing group achieved outstanding results. Moreover, the nailing group had a worse overall result (13.4% vs. 10%). (Table 1, Figure 1 - 5).

Table 1: Comparison of Functional Outcomes Between the Two Groups

Functional Outcome	Group		Total	p-Value
	DCP	IMN		
Excellent	23 76.7%	17 56.7%	40 66.7%	0.37
Good	4 13.3%	9 30.0%	13 21.7%	
Fair	2 6.7%	2 6.7%	4 6.7%	
Peer	1 3.3%	2 6.7%	3 5.0%	
Total	30 100%	30 100%	60 100%	

Although there is disagreement on the optimum treatment, the majority of surgeons concur that intramedullary nailing is the best internal fixation for femoral and tibial shaft fractures.

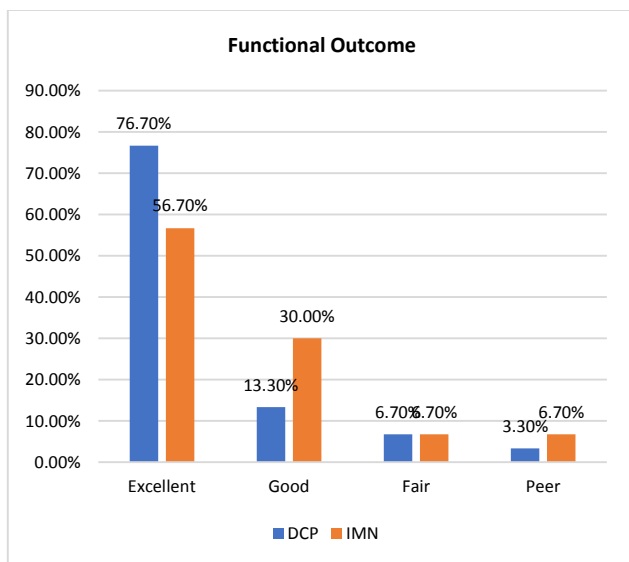


Figure 1: Showing a bar diagram of functional outcome between plating and nailing.



Figure 2: Immediate post operation 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

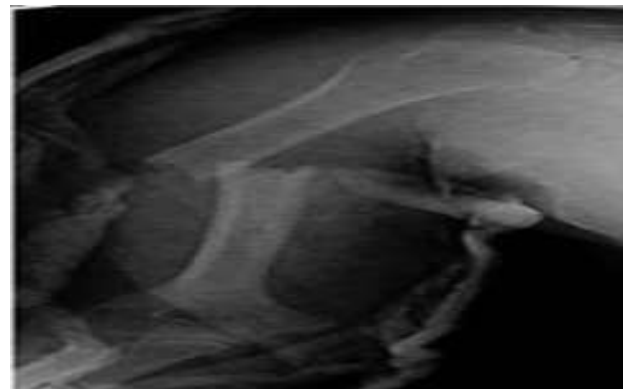


Figure 4: Image showing mid shaft humerus fracture.

Broken humeral shafts. It's not apparent if one approach is superior than the other, though. So, the objective of the current hospital-based comparative study was to assess the functional results of dynamic compression plating

in situations of humeral shaft fractures, an interlocking nail is used. 60 fracture shaft humerus cases in total were prospectively randomised into two groups: Group A is plating (open reduction, internal fixing, and dynamic compression plating), while Group B is nailing (closed reduction and internal fixation with antegrade intramedullary interlocking nail). At nine months or when the patient has fully recovered, whichever comes first, the "Disabilities of the Arm, Shoulder and Hand (DASH)" Questionnaire will be used to evaluate the patient's functional outcome.



Figure 5: Immediate post op X-ray of intramedullary nailing.

DISCUSSION

There was no difference in the mean age of the patients treated with DCP (Dynamic Compression Plating) and IMN (Intramedullary Nailing), which was 40.13 years and 43.67 years, respectively ($p=0.27$). There was no difference in the study groups among the 60 cases, which were equally divided between 65% females and 35% men ($p=0.103$). In their study, Joly A et al. found that the mean age of patients in the nailing and plating groups was 45.3 and 49.5 years, respectively, with a male majority in both groups (55% vs. 45%)⁽⁸⁾.

In their study, Gude N et al. found that the average age of the patients was 37.28 years, with 71.1% of men and 28.9% of women. The patients in the plating group in the research by Saroj et al. varied in age from 22 to 60 years old, with a mean of 37.28 years⁽⁹⁾. The interlocking group's members varied in age from 23 to 70, with a mean age of 35.05 years. 13 men and 5 girls were in the plating group. The interlocking group consisted of 14 men and 6 women. In their study, Rabari Y et al. found that patients treated with DCP (Dynamic Compression Plating) had a mean age of 40.12 years, whereas patients treated with IMILN (Intra Medullary Interlock Nailing) had a mean age of 41.96 years⁽¹⁰⁾. Men were 81.1% of all cases, while women were 18.9%. Patients were found to be on average 35.77 years old, with a male to female ratio of 7:3. Road traffic accidents accounted for the majority of fracture shaft humerus injuries (83.3%), followed by falls (13.3%). RTA (47%) and falls from height (25%) were the two most frequent modes of injury seen in the study by Joly A et al. In their study, Gude N et al. found that falls from height occurred in $n=7$ (18.4%) instances, whereas road traffic accidents (RTA) occurred in $n=27$ (71.1%) cases⁽¹¹⁾. RTA is the most frequent method of injury in both categories, according to Saroj et al studies with falls coming in second. Similar to other studies, RTA was the leading cause of humerus shaft injuries in Rabari et al studies (84.9%), followed by falls (8%). Partap Singh et al. also noted that roadside accidents were a prevalent cause of injury in 63.33% of cases⁽¹²⁾.

Out of the 60 patients of humerus shaft fracture, 30% occurred in the lower shaft, 55% in the middle, and 15% in the upper shaft. Left sided fractures made up a total of 48.3% of cases, while right sided fractures made up 51.7%. In their investigation, Joly A et al. found that fractures of the shaft of the humerus impacted both sides equally, with no preference for any specific laterality. In their investigation, lower shaft fractures were the most often found, then mid shaft fractures. Gude et al study⁽¹³⁾ found that the right side was more frequently affected than the left side in $n=23$ (60.5%) cases compared to $n=15$ (39.5%) cases⁽¹³⁾. In both groups, the middle third of the diaphysis (55.3%) and bottom third (27.9%) of the diaphysis were the most frequently

fractured areas. There was no statistically significant difference between the plating group and the interlocking group in the study by Saroj et al., however the right side was the side that was most frequently involved. There were 3 fractures in the top third, 9 fractures in the lower third, and 21 fractures in the middle third of the diaphysis. Fractures were more prevalent on the right side (63.33%) and in the middle third area (53.33%), according to Partap Singh et al⁽¹⁴⁾ when compared to the DCP (Dynamic Compression Plating) group, radiological union occurred substantially more quickly in the IMN (Intra Medullary Nailing) group (14.33 vs 16.14 days; $p=0.05$). In the Jolly et al. trial, the radiological union lasted 14.7 weeks in the plating group compared to 14.6 weeks in the nailing group. Fracture union was seen in the Gude N et al. research at 16 weeks for the plating group and 14 weeks for the IMN (Intra Medullary Nailing) group. The range for radiological union was 8–34 weeks, with a mean of 15 weeks⁽¹⁵⁾. The average amount of time required for fracture union in the plating group was 16.06 weeks (range: 8–24 weeks), whereas the average in the IMN group was 14.05 weeks (range 8-18 weeks). In the study by Saroj et al., the radiological healing process took an average of 15.05 weeks (14.05 in interlocking group and 16.06 in plating group). In their study, Rabari et al. found that the average radiological healing time for patients treated with Dynamic Compression Plating (DCP) was 14.42 weeks (SD: 0.64), whereas the average healing time for patients treated with Intramedullary Interlock Nailing (IMLN) was 13.35 weeks (SD: 0.56). As a result, the interlocking group's healing rate was somewhat higher than that of the plating group⁽¹⁶⁾.

Compared to the IMN group, the DCP group's mean DASH score was considerably lower (17.10 vs. 23.93; $p=0.05$), indicating that the plating group had a superior functional result. In the plating group, 76.7% of the cases had outstanding results, compared to 56.7% in the nailing group⁽¹¹⁾. Additionally, the nailing group was more likely to have a poor to fair result (13.4% vs. 10%). 90% of patients handled with plating had excellent or good functional outcomes, according to Joly A et al research, compared to 80% of those managed by nailing. 10% of plating patients had poor outcomes, compared to 16.7% of nailing cases⁽¹⁷⁾. In their investigation, Gude N et al. found that of the $n=10$ participants who had outstanding outcomes, $n=8$ (44.44%) instances used plating and $n=2$ (10%) had interlocking nailing. $N=6$ (30%), $N=8$ (40%) and $N=4$ (20%) of the patients who had intramedullary nailing demonstrated good outcomes, fair results, and poor results, respectively^(2,5). Patients who had plate fixation had outcomes in six (33.33%) cases that were good, two (11.11%) that were fair, and two (11.11%) that were bad. In the study by Saroj et al., 77.8% of the plating group's cases had excellent to good outcomes compared to 40% in the nailing group, whereas 11.1% and 20%, respectively, of the plating group's cases had poor outcomes⁽¹⁸⁾. Excellent to good results were recorded in 80.7% of plating instances and only 48.1% of nailing cases, according to Rabari et al., whereas poor results were seen in 3.3% and 14.8% of cases, respectively. Excellent outcomes were seen in 22 patients (73.3%) in the locking plate group and 18 patients (60%) in the locking nail group, according to Ghosh S et al. According to Partap Singh et al., DCP patients exhibited 80% great outcomes with 20% instances displaying satisfactory results, whereas ILN patients showed 20% outstanding results and 46.67% good results⁽¹⁹⁾. In general, the plating group saw less issues (16.7% vs 33.3%; $p=0.27$) than the nailing group. 10% and 3.3% of instances of superficial infections, 10% and 6.7% of stiffness, 6.7% and 0% of impingement, and 6.7% and 0% of cases of non-union in the nailing and plating groups, respectively, were observed. One instance of plating and none of the nailing group had implant failure^(12,4). Out of 30 patients in the plate group who had a closed acute humeral shaft fracture, sequelae included infection (6.6%), delayed union (13.3%), shoulder movement limitation (13.3%), and elbow movement restriction (6.6%)⁽¹⁰⁾.

Out of 30 patients in the nail group, the following problems occurred: shoulder discomfort (46.6%), elbow pain (6.6%),

infection (6.6%), delayed union (26.6%), shoulder mobility limitation (13.3%), and splintering of the fracture end (6.6%). In the research by Joly A et al, the overall complication rate was 40% in the nailing group and 30% in the plating group⁽⁸⁾. Infections on the skin's surface occurred in 10% and 6.7% of cases, respectively, whereas non-union occurred in 6.7% and 3.3% of cases in the nailing and plating groups. Implant failure was seen in 3.3% of nailing cases and 6.7% of nailing instances. In the study by Gude N et al., problems occurred in 33.3% (6/18 cases) of plating cases compared to 65% (13/20 cases) of nailing cases⁽¹⁾. Two cases of plating group non-union and zero occurrences of nailing were seen, but one incidence of implant failure per group was observed. In their study, Saroj et al. found that interlocking nailing had more general problems than plating, which was statistically significant ($p=0.009$). There was no union in the nailing group and two occurrences of plating⁽⁴⁾. In the plating and nailing groups, Rabari et al. found non-union rates of 3.7% and 0% whereas infection rates were 3.3% and 10%, respectively⁽²⁰⁾.

The nailing group saw a higher overall complication rate ($p<0.05$). In conclusion, both treatment modalities (dynamic compression plating and interlocking nailing) had positive functional results. Nevertheless, plating provides greater results in terms of improved shoulder joint functionality. Moreover, plating had a lower overall complication rate than nailing. Hence, for fracture shaft humerus, we advise dynamic compression plating over interlocking nailing as the recommended technique.

CONCLUSION

For patients having surgical intervention for humeral shaft fractures, locking plating and intramedullary nailing have shown statistically equivalent outcomes. Both offer great and favourable results in terms of union and function; however, the dynamic compression plating group had a larger percentage of good outcomes and a predisposition for union.

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