



## Management of Humeral Shaft Fracture: A Prospective Comparison of Dynamic Compression Plating and Interlocking Nails

Dr Prafulla Borkar

Associate Professor Dept of Orthopedics, Jawaharlal Nehru Medical College, Sawangi Meghe, Wardha

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Corresponding Author:

**Dr Prafulla Borkar**

Associate Professor Dept of  
Orthopedics, Jawaharlal Nehru  
Medical College, Sawangi Meghe,  
Wardha

### ABSTRACT

**BACKGROUND:** The best course of action for surgical intervention for humerus shaft fractures is up for dispute. Over the course of three years, a prospective, comparative study was conducted to compare the management of acute humeral shaft fractures treated with dynamic compression plating and antegrade interlocking nail fixation. After taking into account the inclusion and exclusion criteria, twenty patients with interlocking nailing and sixteen patients with plating were included. Postoperative assessment was conducted using functional scoring criteria, with an average follow-up time of one year. With the plating group in our series, there was a tendency for the earlier union and a larger percentage of outstanding and good results. Three percent of all fractures are humeral diaphyseal fractures. But conservative medicine has drawbacks of its own. Second, it can't be suggested in every situation.

**AIM:** The aim of this investigation was to evaluate the humeral nailing system according to clinical results, and to recognize the advantages and disadvantages of interlocking.

**MATERIAL AND METHOD:** The Department of Orthopedics was the site of the prospective observational study. As a result, thirty patients underwent surgery—fifteen under plating and fifteen under nailing. We employed the anterolateral approach in the supine position and the posterior approach in the lateral position during compression plating. The location and shape of the fracture will determine which method is best. Every patient had a 4.5 mm compression plate DCP, and lag screws were utilized for interfragmentary compression where necessary. Typically, a plate was utilized that allowed screw fixation to a minimum of six cortices in both the proximal and distal segments. Following the acquisition of signed informed permission, prospective patients were screened. Adult patients of both sexes who had a radiologically confirmed clinical diagnosis of a diaphyseal fracture of the humerus were included.

**RESULTS:** The patients in this study ranged in age from 19 to 69, with a mean age of 42.30. The majority of patients (24.66%) were in the 26–36 age group, with 21.33% coming from the 66–76 age range. Of the thirty patients, sixteen (60%) were men and fourteen (40%) were women. The highest percentage of cases experienced a minor fall or stumble (30.00%), followed by RTA (26.66%) and serious trauma (26.66%). Of the patients, 20% were unstable and 30% underwent surgery when polytrauma was discovered. Poor skin problems required surgery for four patients (13.3%). The percentage of obese patients was comparable. Two patients required intervention due to oblique fractures, even though 10% of patients had pendulous breasts.

**CONCLUSION:** Dynamic compression plating has proven to be a reliable technique for stabilizing humeral transverse diaphyseal fractures over time. Osteosynthesis is aided by the compression the plate creates at the fracture site. However, the method is not appropriate for fractures that are significantly closer or farther from the shaft, pathological fractures, comminuted fractures, segmental fractures, extensive osteoporosis, or non-union. With the advent of interlocking nailing, many of the issues with the conventional dynamic compression plating process have been resolved.

**KEYWORDS:** Dynamic Compression Plate, Fracture, Humerus and Interlocking Nail

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### INTRODUCTION

The group of fractures where the main fracture line is located proximal to the supracondylar ridge and distal to the surgical neck of the humerus is included in the humerus' fracture shaft. It is responsible for around 3.5% of all bone fractures.<sup>1</sup> Of the injuries, 63% had simple fracture patterns and 5% had an

open wound. Treatment for simple humeral fractures involves reduction and immobilization of the arm; approximately 90% of cases result in good union.<sup>2</sup> Though non-operative treatment has long been acknowledged as an effective treatment option for humeral shaft fractures, surgical management of humeral fractures is now under acceptance as a first

choice of management due to recent advancements in fracture fixation technique and biomaterials, the success of improved surgical treatment and low rates complication rates, and better efficacy of managing complications.<sup>3</sup> Since the turn of the century, trauma has been the primary cause of both mortality and morbidity. The individual who has a bone injury may be rendered immobile for an extended period of time, which may require them to miss work, further burdening their family. The patient also experiences functional impairment and stiff joint issues. The best fracture treatment presently appears to be early joint motion restoration, return to normal physiologic function, and minimal morbidity. Three percent of all fractures are humeral diaphyseal fractures.<sup>4,5</sup>

Although the conservative approach to treating humeral shaft fractures is well-established, it is limited in situations involving multiple fractures, non-compliance, obesity, and severe soft-tissue injury.<sup>6</sup> The gold standard of surgical treatment is open reduction with internal fixation, although issues such as severe soft tissue stripping, damage to the radial nerve, and challenges with intricate fracture patterns are well known. As a result, a large range of fixation tools are now accessible for the treatment of these fractures; nonetheless, the best technique for reduction and fixation remains undetermined.<sup>7</sup> In an attempt to replicate the effectiveness of comparable devices used in the lower extremities, humeral locking nails were produced. As opposed to plate osteosynthesis, interlocking nails were expected to result in reduced soft tissue damage, closed reduction, and stabilization of complex fractures that preserved the periosteum. Younger patients' causes are typically characterized by high-energy trauma, whereas older patients' causes are typically characterized by lower-energy trauma and are frequently linked to osteoporosis.<sup>8</sup> Establishing a union with appropriate humeral alignment and returning patients to their previous level of function are the objectives of managing humeral shaft fractures. Numerous techniques have been documented for the treatment of fractures to the humerus. Ninety percent of instances of humeral shaft fractures heal successfully with conservative treatment of reduction and subsequent immobilization of the arm.<sup>9</sup>

Although there were many conservative methods for treating fractures, an age of fixation emerged with the goal of minimizing morbidity and returning to normal physiological function as soon as possible, while also restoring joint motion as soon as possible. Although there are various surgical approaches for treating humeral diaphyseal fractures, the internal

fixation procedures can be generically classified as either plating or intramedullary nailing.<sup>10</sup> For comminuted, segmental, and pathological fractures, interlocking nailing is the better choice; however, plating would be the better choice if radial nerve exploration is being considered, and if nonunion, radial nerve palsy, and infection are general concerns raised in the plating group. In order to determine the best surgical therapy strategy for humeral diaphyseal fractures and its functional outcome, we wish to perform a prospective, comparative study. The choice of implant for internal fixations is still up for debate.<sup>11</sup>

## MATERIAL AND METHODS

The Department of Orthopedics was the site of the prospective observational study. As a result, thirty patients underwent surgery—fifteen under plating and fifteen under nailing. We employed the anterolateral approach in the supine position and the posterior approach in the lateral position during compression plating. The location and shape of the fracture will determine which method is best. Every patient had a 4.5 mm compression plate DCP, and lag screws were utilized for interfragmentary compression where necessary. Typically, a plate was utilized that allowed screw fixation to a minimum of six cortices in both the proximal and distal segments. Following the acquisition of signed informed permission, prospective patients were screened. Adult patients of both sexes who had a radiologically confirmed clinical diagnosis of a diaphyseal fracture of the humerus were included. Evaluating the functional outcome of IINF in the broken humeral shaft was the study's main goal. Furthermore, the study examined the potential hazards, intricacies associated with the interlocking nailing method, the duration required for fracture consolidation, union rates, and the need of prompt rehabilitation.

### Inclusion criteria

The following criteria were included in the study:

- The age of the patient is more than 18 years.
- The patient presented within 2 weeks of the injury.
- All closed types of displaced diaphyseal fractures of the humerus.
- Patients with Grades 1 and 2 open diaphyseal fractures of the humerus presenting within 8 h of injury.

### Exclusion criteria

The following criteria were excluded from the study:

- Refracture of diaphyseal fractures of the humerus.
- Pathological fractures.
- Neglected diaphyseal fractures of the humerus

- Fractures within 4 cm from the proximal and distal end of the humerus.
- Grade 3 compound diaphyseal fractures of the humerus.
- Age of the patient

Next, a guide wire was put inside the reamer. Furthermore, fracture reduction was accomplished by manipulating proximal fragments with a reamer, a reduction tool. A guide wire was inserted into the distal piece after this. Following this, the distal section was reamed up to two centimeters over the olecranon fossa's proximal boundary. Up to 1 mm more than the target nail size was then sequentially reamed again. The length of the nails was measured using a fluoroscope. Next, without using any force and with careful handling, the intended nail fitted with a proximal jig was inserted over the guide wire.

The closest end The nail was retained in the humeral head 2–5 mm below the surface. The distal end was maintained 2 centimeters above the olecranon fossa's proximal edge. Fluoroscopy was used to confirm the location. Under the direction of fluoroscopy, distal locking was performed using a minimum two cortical bolt. After then, a light back hammer was used. The compression at the fracture site was assessed using fluoroscopy. Following this, proximal locking was completed with the guide's assistance. As they gained more traction, the second and third holes were locked. Later, internal and

external rotation was used to verify the stability of the fracture site. The cuts were sealed, and the entry site was appropriately irrigated. Following surgery, the patient was given a sling and instructed to return to the outpatient department.

**Follow up visits**

1st visit – 2 weeks after surgery. Stitch removal was done and shoulder and elbow mobilization was advised. 2nd visit – 6 weeks following surgery. During this visit, both shoulder and elbow movements were evaluated. Tenderness at the fracture site was noted. If evidence of union was seen full mobilization was advised. The patient was further followed up at 12 and 24 weeks. Then once every three months.

**STATISTICAL ANALYSIS**

The result was analyzed statically using SPSS 11.5 software with a student key test and non-parametric test. The value of alpha was set at 0.05.

**RESULT: -**

In this study, the age range of patients was 19-69 years with the mean age being 42.30 years. Maximum patients were from the age range 26-36 years (24.66%) followed by 66-76 years (21.33%). Out of 30 patients, 16 were male (60%) whereas 14 (40%) were female. maximum cases had a minor slip or stumble 30.00%, the second most common mode of injury was RTA (26.66%) and major trauma (26.66%).

**Table 1: Patients’ characteristics who participated in the study.**

	<b>Plating</b>	<b>Nailing</b>	<b>Total</b>
Sex Male	10	6	16
Female	6	8	14
Side Right	8	4	12
Left	7	11	118
Age mean	43.50	44.10	42.30
AO subtype			
A1	3	0	3
A2	10	1	11
A3	1	8	9
B2	1	6	7
Avg. Union- time (App.)	6.9 months	8.7 months	7.8 months

Additionally, there were one case of plating suffering delayed union and two cases of nailing. Two patients in the current series had nerve damage from plating, but they healed in less than six months. In the nailing group, no patient experienced nerve damage. Just 10% of the comminuted categories were the least common. The distribution of male and female patients by age groups did not differ statistically, despite the fact that there was a variation in the proportions of participants based on gender and age.

**Table 2: Distribution of the Study Participants as Per the AO Classification Of The Injury Sustained.**

AO Classification	No of Patient	Percentage (%)
A1	5	16.6 %
A2	6	20 %
A3	10	33 %
B1	5	16.6 %
B2	1	3.33 %
B3	0	0 %
C1	2	6.66 %
C2	1	3.33 %
C3	0	0 %

The majority of the patients (33%) had injury of class A3 as per the AO classification. While 20% had A2 injuries, 16.6% of the patients had injuries of class A1. Comparable to A1 injuries, another 16.6% of patients sustained the B1 class of injury. No patients sustained C3 or B3 class of injury.

**Table 3: Distribution Of the Patients According to Indications Of Operative Intervention.**

Indication	Number of patients	Percentage
Polytrauma	9	30%
Unstable fracture	5	20%
Oblique fracture	3	9.99%
Obese	4	13.3%
Poor skin condition	4	13.3%
Pendulous breast	3	9.99%
Non-compliant	2	6.66%

Among the patients, 30% were operated on following the indication of poly-trauma and another 20% were unstable. Four patients (13.3%) were operated on because of poor skin conditions. A similar number of patients were obese. While 10% of patients had pendulous breasts, two patients had oblique fractures leading to intervention.

## DISCUSSION

While operational stabilization is necessary in a small number of cases—particularly those with inadequate closure reduction and numerous injuries—conservative care of shaft humerus fractures frequently results in a satisfactory therapeutic outcome. Furthermore, orthopedic doctors and patients alike favor surgery in these cases because it provides prompt symptom alleviation and restores joint function. The development of more advanced methods has reduced problems and made surgery easier to execute. Although there is a chance of radial nerve injury and refracture following implant removal, plate osteosynthesis has a high success rate but necessitates substantial dissection. Intramedullary nailing is the preferred surgical procedure due to its benefits; nevertheless, the application of unlocked flexible nails has been hindered by inadequate rotational stability and nail sliding that irritates the joint.<sup>12</sup> These shortcomings are addressed by locked

nailing, which produces acceptable therapeutic results. In the recent past, it has been regarded as the preferred course of treatment for humeral shaft fractures.<sup>13</sup>

**Robinsons et.al.1992**<sup>14</sup> reported 17%, and in the series of **Srivastava et.al.1999**<sup>15</sup> 15% and 11% in **Lin's1998**<sup>16</sup> were the patients with shoulder stiffness. According to the Constant Murley score, 2 patients (12.5%) in the current series had stiff shoulders. There are similarities between this series and others.<sup>17</sup> When the rehabilitation was adequately followed, the recovery of complete shoulder function took an average of twelve weeks. Protrusion of the nail at the entry point, damage to the rotator cuff during nail insertion, insufficient removal of bone debris following nailing from the entry point, proximal migration of the nail, and noncompliance with the postoperative physiotherapy regimen are the reasons for stiffness. Out of the two patients in this series who experienced shoulder discomfort, one had a nail protrusion at the entry location. The other experienced just mild restrictions on shoulder movement, which resolved after appropriate rehabilitation and physiotherapy.

**Marchetti et al.2000**<sup>18</sup> Reported fracture of the middle 3rd of the humerus was common (85.25%) in their study population. Simple transverse fracture of the A3 type was frequent (47.54%). Radial nerve

palsy was seen in 14.75% before surgery and one patient developed nerve palsy, postoperatively. There was no incidence of infection. Functional outcome was good at 85.42%. Nonunion was the complication seen in 7.14%.

**Riemer et al.1996**<sup>19</sup> state that residual irritation or thickening of the rotator cuff tendon or coracoacromial ligament is the cause of shoulder stiffness. None of the patients in our series who had plating experienced shoulder discomfort. For both surgical procedures, the percentage of patients with higher ASES ratings at 24 weeks was similar. As a whole, 50% of the patients had ASES scores between 45 and 49.

**Lal et. al.1999**<sup>20</sup> in one case (4.5%). This complication is encountered due to damage to the upper lateral cutaneous nerve of the arm while performing proximal locking. There was no anesthetic in the regimental badge area in any of the cases in the current interlocking series. It is imperative to take appropriate measures to prevent these kinds of issues. The optimal position for the nail is 5 mm below the entry point, according to the Wheelless Textbook of Orthopedics. The proximal interlocking screw occurs at the level of the axillary nerve and puts the nerve at risk if the nail is counter linked more than 1 centimeter below the articular surface. Therefore, to prevent this consequence, one should ensure that the proximal locking screw is positioned above the humeral surgical neck. In the plating series, this issue was not observed.

Due to their stronger bones and broader medullary canals, people in the West require thicker implants. Two cases—one from the plating group and the other from the nailing group—have undergone non-union in this series of investigations. Additionally, there were one case of plating suffering delayed union and two cases of nailing. Non-union of the humerus shaft typically results from soft tissue interposition, osteoporosis, comminution, and distraction. These are significant indicators of nonunion status. Following stitch removal, patients are recommended to gradually engage in active or passive physiotherapy. In this series, elbow and shoulder joint functional activity was evaluated using the American Shoulder and Elbow Surgeon score, the Constant and Murley Score for shoulder function activity, and the Myo Elbow performance score specifically for elbow function.<sup>21</sup> The plating group's 66.66% and the interlocking group's 60 demonstrated good performance based on the shoulder score. 26.66% of the plating group and 33.33% of the nailing group demonstrated the favorable outcome. According to ASES, both groups' functional activity of the upper

limb has generally recovered. Elbow performance was excellent in 73.33% of nails and 60% of plating. Good in 20% of the nailing and 33.33% of the plating. Good functional recovery is achieved with early limb mobilization and partial physical therapy.<sup>22</sup>

Obtaining a full range of motion for these individuals required extremely early post-operative mobilization of the elbow and shoulder. Early, rigorous physical treatment accelerated the recovery of shoulder function. The patient's devotion to the rehabilitation program determines the shoulder's motions and functional capacity. An interlocking nail used in closed intramedullary nailing is a dependable and safe treatment for fractures of the humerus. Closed nailing is the least intrusive surgical method available with the lowest risk of infection following surgery. It shortens the hospital stay's duration. By applying intraoperative compression and preventing distraction at the fracture site, complications such as nonunion can be prevented. To prevent impingement and improve shoulder function, a few technical details are crucial, such as burying the proximal nail end at the entry portal.

#### **CONCLUSION:**

Dynamic compression plating has proven to be a reliable technique for stabilizing humeral transverse diaphyseal fractures over time. Osteosynthesis is aided by the compression the plate creates at the fracture site. However, the method is not appropriate for fractures that are significantly closer or farther from the shaft, pathological fractures, comminuted fractures, segmental fractures, extensive osteoporosis, or non-union. With the advent of interlocking nailing, many of the issues with the conventional dynamic compression plating process have been resolved. One benefit of humeral interlocking is the ability to do everyday activities even in cases of non-union development, which was challenging in cases of screw loosening. For the management of humeral shaft fractures, closed intramedullary nailing is a great minimally invasive surgical alternative that has improved union rates and early fracture consolidation. It lowers morbidity, shortens hospital stays, and offers early recovery. For people who have osteoporosis and polytrauma, it is ideal. Intense physical therapy administered early on speeds up shoulder function recovery.

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