

ORIGINAL RESEARCH

Compare the Duration of Fracture Healing in Dynamic Compression Plating & Interlocking Nail in Fixation of Fracture Shaft Humerus

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ABSTRACT

Background: Fractures of shaft of humerus account for nearly 3% of all fractures and 20% of fractures to the humerus. Objective: Compare the duration of fracture healing in Dynamic Compression Plating & Interlocking Nail in fixation of fracture shaft humerus.

Methods: The present study was conducted in the Department of Orthopaedics, Govt. multispecialty Hospital, Sec. 16, Chandigarh during the years 2010-12. In this study 15 patients for each group i.e. Dynamic Compression Plating and Interlocking Nail were studied.

Results: In the present series 24 out of 30 cases (80%) united. Out of 24 cases which united 21 (87.5%) united within 16 weeks, 2 cases united between >16 -24 weeks and only 1 case united at 32 weeks. Remaining 6 cases did not unite even at the expected time of union for humeral shaft fractures. Mean union time in nailing group was 15.27 ± 6.21 wks while in the plating group it was 15.23 ± 3.32 wks.

Conclusion: Overall plating is a better procedure than interlocking nail for fracture shaft humerus. The mean union time was 15.27 ± 6.21 weeks in nailing group and 15.23 ± 3.32 weeks in plating group. In our study the overall union rate was 80% (24 out of 30 cases united).

Keywords: Mean union time, complications, Dynamic Compression Plating, Interlocking Nail in fixation, fracture shaft humerus

INTRODUCTION

The goal of operative treatment of humeral shaft fractures is to restore length, alignment, and rotation with stable fixation that allows early motion.¹

Options for fixation include plate osteosynthesis, intramedullary nailing, and external fixation with each method resulting in predictably high union rates.² Each operative method has its own relative risks and benefits.³

External fixation generally is reserved for high-energy gunshot wounds, fractures with significant soft-tissue injuries, and fractures with massive contamination & in poly-traumatized unstable patients who can't take the stress of internal fixation the so called Damage Control Orthopaedics.⁴

Usually, plate fixation is achieved by a dynamic compression plate (DCP), and it is generally accepted that this gives satisfactory results.⁵ Plate osteosynthesis has been described as gold

standard for fixation of fracture shaft of Humerus by some authors^{9,17,19} with reported union rate of 95% to 97%.⁶ It has the advantage of reduction under direct vision and almost perfect reduction.

Plating can be used for fractures with proximal and distal extension. It provides enough stability to allow early upper extremity weight bearing in polytrauma patients and produces minimal shoulder or elbow morbidity. Commonly used plate for fixation of humeral shaft fractures is the 4.5-mm Dynamic Compression Plate, could be narrow or broad, Limited-Contact Dynamic Compression Plate, either of stainless steel or titanium. Locking plates are the recent advances in management of the fractures and have shown lot of promise especially in proximal 1/3rd fractures⁷ and osteoporotic bones.^{23,24}

Use of this plate, however requires extensive dissection and is complicated by the proximity of radial nerve, increased blood loss, disruption of periosteal blood supply, risk of mechanical failure in osteoporotic bone.^{5,6} As a result of recent technical advances, there is growing interest in the use of humeral Intramedullary nail.⁸

Intramedullary Nailing made significant progress in management of fracture shaft of Humerus in early 90s. There has been a gradual advancement in modification of designs of nails from earlier Seidel nail to latest ILN. Seidel nails with spreading fins have the advantages of Intramedullary nailing^{9,10} but their use is complicated by iatrogenic comminution, torsional instability and shoulder impairment.⁸ The newly developed locked nails with transfixing screws have the advantage of adding to rotational stability which is very much required in Humerus because of high amount of torsional stress in shoulder joint.^{11,12} These nails are usually used in segmental fractures, pathological fractures, can be used for fractures especially in females because of aesthetics of surgery as it leaves little/no surgical scar.

Browner et al¹³ and Rockwood and Green¹⁴ recommend fixation of diaphyseal fractures of the Humerus by an IMN which can be inserted into the Humerus antegrade, from the shoulder or retrograde, from the elbow.

Biomechanically intramedullary nail is a better implant. They are subjected to smaller bending loads and are less likely to fail by fatigue, they act as load sharing devices, stress shielding with resultant cortical osteopenia is minimal, refracture after implant removal is rare and they do not require extensive exposure and provides autograft material during reaming.¹⁵ But the interlocking nails are also not free of complications which are higher rate of non-union, shoulder impairment and operative comminution.¹⁶

The present study is intended to compare the duration of fracture healing in Dynamic Compression Plating & Interlocking Nail in fixation of fracture shaft humerus.

MATERIALS AND METHODS

The present study was conducted in the Department of Orthopaedics, Govt. multispecialty Hospital, Sec. 16, Chandigarh during the years 2010-12. In this study 15 patients for each group i.e. Dynamic Compression Plating and Interlocking Nail were studied. Each patient was subjected to detailed history, clinical examination and necessary investigations including X-rays of the part.

Inclusion Criteria

1. Fresh fractures (less than 3 weeks old).
2. Humerus shaft fractures upto type 12- B2 according to A.O. Classification.
3. Fractures located between 5 cm distal to surgical neck or 5 cm proximal to the olecranon fossa.

4. Grade I or 2a compound fracture.
5. Polytrauma
6. Early failure of conservative treatment.
7. Unstable fractures

Exclusion Criteria

1. Compound Grade III fractures.
2. Old ununited fractures whether neglected or surgically failed.
3. Pathological fractures
4. Segmental fractures

Methods

The patient's attendants were explained about the nature of injury & its possible complications. Patient's attendants were also explained about the need for the surgery & complications of surgery.

Written & informed consent was obtained from the patient for surgery. Medical evaluation of the patient was done after consulting the Physician. Hygiene of the skin was maintained with regular scrub with betadine. Injection Tetvac was given, the affected arm with the axilla was scrubbed with savlon & betadine. The anaesthetist was informed, pre-operative parenteral antibiotic (preferably Cephalosporins) was administered one hour before surgery (Post-operatively continued for 48hrs & then converted into oral antibiotics till the next 5 days). The patient was shifted to the operation theatre with the x-rays & drugs.

Operative Technique

Anesthesia:- Under General Anaesthesia/regional anaesthesia

Patients Positioning:

The patient was placed in Lateral position for Posterior approach (with arm hanging on side-post) & Supine position for Antero-Lateral approach, and arm chair position (sandbag was placed in inter scapular region) for interlocking nail.

Draping:-

The arm and the axilla were cleaned with betadine scrub for 10 minutes, painted with betadine solution & spirit, draped with linen & opsite over the proposed incision site.

Technique of Insertion of Interlocking Nail

- The length of the nail was measured in cm, by measuring the length between the greater tuberosity and the lateral epicondyle and 3 cms were subtracted from it. Diameter was assessed by the x-ray of the humerus.
- Patient was put on a radiolucent table with the thorax "bumped" 30 to
- 40 degrees or pillow was placed under the scapular blade; this increased the exposure of the shoulder with arm in adduction as much as possible. The image intensifier unit was placed on the opposite side of the table from the surgeon;
- Table was moved so that the foot end became head end for free movement of image intensifier.
- Entry point was made under image intensifier with 2mm k-wire just lateral to tip of acromion and medial to the greater tuberosity at articular-nonarticular junction after confirming in both sagittal and coronal planes.
- Over the k-wire cannulated bone awl was passed under c-arm guidance.
- **Insertion handle (Jig)**

The insertion handle was mounted on the proximal end of the nail using the connection screw. It was ensured that the convexity of the nail curvature pointed away from the insertion handle.

Nail insertion

- The nail was advanced in the proximal shaft fragment using gentle rotatory movements. The nail was advanced just beyond the fracture site.

Reduction

- Reduction was achieved by traction, forearm was kept in supination. After passing the fracture site, humeral shaft alignment, rotation, and length was adjusted under image intensifier. .

Interlocking

- Proximal interlocking with two screws or single oblique screw was placed. To prevent the nail from backing out, proximal interlocking was done first.
- Wound closure
- All wounds were irrigated and cleaned. Skin closure was performed with ethilon or staples.

Technique of open reduction and DCP application

Exposure:-

1. Antero-Lateral Approach:
2. Posterior Approach

Post-operative Management was done and results were assessed based on:

1. Deformity.
2. Range of Movements both of shoulder & elbow.
3. Fracture Union clinically & radiologically.

Statistical Analysis

The quantitative data (age, union time) were presented as mean ± SD. T-test was applied for comparison of two groups. Pearson χ^2 test or Fisher’s exact test was used for analysis of categorical data. A *P* value of <0.05 was considered to indicate statistical significance.

RESULT

Of the 30 patients treated in our series, youngest patient was 19 years old and oldest was 68 years old. Overall mean age in our study was 42.43 ± 12.50 years. 22 out of 30 cases (73.33%) were in the age group of 30-60 years.

Table 1: Age distribution of patients

Age group		Type of Surgery		Total
		Nailing	Plating	
<=20	No. of patients (%)	0 (.0%)	1 (6.7%)	1 (3.3%)
21-30	No. of patients (%)	2 (13.3%)	4 (26.7%)	6 (20.0%)
31-40	No. of patients (%)	2 (13.3%)	5 (33.3%)	7 (23.3%)
41-50	No. of patients (%)	5 (33.3%)	2 (13.3%)	7 (23.3%)
51-60	No. of patients (%)	5 (33.3%)	3 (20.0%)	8 (26.7%)
>60	No. of patients (%)	1 (6.7%)	0 (.0%)	1 (3.3%)
	Total (%)	15 (100.0%)	15 (100.0%)	30 (100.0%)

p value 0.3333 Statistically Insignificant

In our study the male to female ratio was 1.14:1

Table 2: Gender distribution of patients

Gender		Type of Surgery		Total
		Nailing	Plating	
Female	No. of patients (%)	8 (53.3%)	6 (40.0%)	14 (46.7%)
Male	No. of patients (%)	7 (46.7%)	9 (60.0%)	16 (53.3%)
	Total (%)	15 (100.0%)	15 (100.0%)	30 (100.0%)

In our study 17 of 30 cases (56.7%) had injury of the right arm. The commonest mode of injury in the present series was Road Traffic Accident accounting for 83.3% of the cases, whereas only 16.7% (5 out of 30) sustained injury during fall. In our study the commonest AO type of fracture was 12-A (19 out of 30 cases) whereas, 12-B type of fractures were 11 out of 30 cases.

Table 3: Open/Closed Fracture

		Type of Surgery		Total
		Nailing	Plating	
Closed	No. of patients (%)	14 (93.3%)	13 (86.7%)	27 (90.0%)
Open	No. of patients (%)	1 (6.7%)	2 (13.3%)	3 (10.0%)
	Total (%)	15 (100.0%)	15 (100.0%)	30 (100.0%)

p value 1.000 Statistically Insignificant

Mean operative time of nailing and plating group was 70 ± 13.63 min (range 50-90 min) and 69.33 ± 12.23 min (range 60-90 min) respectively, which was almost equal.

In the present series 2 out of 30 cases (6.7%) had angulatory deformity. In both the cases the deformity was less than 100.

Mean duration of hospital stay in the nailing group and plating group was 7.80 ± 3.61 days (range 4-14 days) and 8.73 ± 1.53 days (range 6-10 days) respectively. Mean duration of hospital stay was almost equal with both modalities ~ 8 days.

Table 4: Time for Union

Time for union	No. of patients		
	Nailing	Plating	total
10-16 WEEKS	9 (81.8%)	12 (92.3%)	21 (87.5%)
16-20 WEEKS	1 (9.1%)	0 (.0%)	1 (4.2%)
>20-24 WEEKS	0 (.0%)	1 (7.7%)	1 (4.2%)
> 24 WEEKS	1 (9.1%)	0 (.0%)	1 (4.2%)
Total	11 (100%)	13 (100%)	24 (100%)
Not -United	04	02	06

p value 0.350 Statistically Insignificant

In the present series 24 out of 30 cases (80%) united. Out of 24 cases which united 21 (87.5%) united within 16 weeks, 2 cases united between >16 -24 weeks and only 1 case united at 32

weeks. Remaining 6 cases did not unite even at the expected time of union for humeral shaft fractures.

Mean union time in nailing group was 15.27 ± 6.21 wks while in the plating group it was 15.23 ± 3.32 wks.

Table 5: Results

Result	No. Of Patients		
	Nailing	Plating	Total
Excellent	7 (46.7%)	11 (73.3%)	18 (60%)
Good	2 (13.3%)	1 (6.7%)	3 (10%)
Fair	Nil	1 (6.7%)	1 (3.3%)
Poor	6 (40%)	2 (13.3%)	8 (26.7%)
Total	15 (100%)	15 (100%)	30 (100%)

p value 0.238 Statistically Insignificant

In our study 70% of the patients (21 out of 30 cases) had excellent to good results. 12 patients had excellent to good results in the plating group and 9 patients had excellent to good results in the nailing group.

46.67% patients in the nailing group and 60% patients in the plating group had no complication in our study. Patients with more than one complication were present. Complications were more in interlocking nail as compared to plating. In our study 6 out of 30 cases (20.0%) had non-union out of which 4 cases were in the interlocking nail group and 2 cases in plating group. 5 out of 30 cases (16.7%) had shoulder stiffness of which 4 cases (80.0%) were in the nailing group and only 1 case in the plating group had this complication.

DISCUSSION

In this study maximum number of patients were in 5th to 6th decade which made up 50% of the total. Youngest patient was of 19 yrs and oldest was 68 yrs with mean age of 42.43 yrs. This mean age is comparable with the study of McCormack et al¹⁷ and Raghavendra et al¹⁸.

Epidemiological study for fracture shaft humerus done by Ekholm et al¹⁹ showed mean age to be 62.7 yrs (16 to 97). Mean age for females was 68.2 yrs and for males 53.9 yrs (16 to 90)

In our study the majority of the patients were males (53.3%). This is comparable to almost all the studies done earlier which are mentioned in the table above. However epidemiological study of Ekholm et al¹⁹ showed female incidence of 61% and male incidence of 39%.

In our study open fractures constituted 10% of the total. All were open grade I (1 case in nailing group, 2 in plating group).

This finding of incidence of open fractures is comparable to the studies of McCormack et al¹⁷ and Raghavendra et al¹⁸. In the epidemiological study of Ekholm et al¹³⁷ incidence of open fractures was 2%.

In the present series mean duration of hospital stay in the nailing and plating group were 7.8 ± 3.61 days (range 4-14 days) and 8.73 ± 1.53 days (range 6-10 days) respectively. The results

were comparable with the study of Chao et al.³ Duration of hospital stay was almost equal with both the treatment modalities.

In the study of Singiseti et al⁴ time taken for union in interlocking nail patients was <16 weeks in 50% of patients and >16 weeks in 50% of patients, while in plating group it was <16 weeks in 75% cases and >16 weeks in 25% cases All the studies, except Raghavendra et al²⁰, showed mean union time of 8- 10 weeks for both nailing and plating groups

There were only 2 cases that developed infection (superficial). Both the cases were in the plating group and both were open (grade I) fractures. This difference was statistically insignificant (p value 0.483). Infection was treated with antibiotics and dressings. There was no incidence of infection in the nailing group. The results are comparable to the reported studies of Chapman et al⁶, Changulani et al⁵ and Lin et al⁷.

The final result in the plating group were 73.3% excellent, 6.7% good, 6.7% fair and 13.3% poor, and in the nailing group it was 46.7% excellent, 13.3% good and 40% poor. Overall, in comparison to plating, result of the nailing group was not good, though this was statistically insignificant (p value 0.238).

In the study of Kesemenli et al²¹ the results in the plating group were 88% good, 8% moderate and 4% poor, and in the nailing group 81% good, 7% moderate and 12% poor.

Putti et al²² found both nailing and plating to be comparable in terms of functional outcome and rates of union, but complication rate was higher in the nailing group.

Changulani et al²³ found no significant difference between nailing and plating in terms of functional outcome and rate of union of the fracture. They considered nailing to be a better surgical option as it offered a shorter union time and lower incidence of serious complications like infection.

Rommens et al²⁴ retrospectively reviewed DCP fixation of the humerus and then prospectively reviewed IMN fixation. They achieved better results with a retrograde IMN than with an antegrade IMN or DCP fixation; they recorded that 90% of their patients regained excellent function in the shoulder and elbow.

The final result in the plating group were 73.3% excellent, 6.7% good, 6.7% fair and 13.3% poor, and in the nailing group it was 46.7% excellent, 13.3% good and 40% poor. Overall, in comparison to plating, result of the nailing group was not good, though this was statistically insignificant (p value 0.238). In the study of Kesemenli et al²⁵ the results in the plating group were 88% good, 8% moderate and 4% poor, and in the nailing group 81% good, 7% moderate and 12% poor.

CONCLUSION

Overall plating is a better procedure than interlocking nail for fracture shaft humerus. The mean union time was 15.27 ± 6.21 weeks in nailing group and 15.23 ± 3.32 weeks in plating group. In our study the overall union rate was 80% (24 out of 30 cases united).

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