

INTERNAL FIXATION OF FRACTURES OF SHAFT OF THE HUMERUS WITH DYNAMIC COMPRESSION PLATE OR INTERLOCKING NAIL: A PROSPECTIVE COMPARATIVE STUDY

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Abstract

Background: In this modern age, because of rapid industrialization, increase in motor vehicles on road and increased life expectancy accidents are on the rise and resulting in rise in number of fractures. To evaluate the role of 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. **Result:** Road Traffic Accident was the most common mode of injury accounting for 83% cases. In the present series 90% of the fractures were closed. Only 3 out of 30 cases were open. All the three open fractures were of grade I. 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). **Conclusion:** Overall plating is a better procedure than interlocking nail for fracture shaft humerus. Nailing to be done only when plating cannot be done especially segmental #, pathological #, severe multiple trauma for DCO. Nailing can be preferred in females because of aesthetics of smaller scars in the arm.

INTRODUCTION

Although most of humeral shaft fractures can be managed conservatively with good to excellent results with a reported success of over 90%,^[1,2] maintaining their axial alignment, length and rotation is difficult because of the anatomical configuration of the shaft of the humerus which makes it prone for residual fracture site distraction, especially where the sagittal diameter of the distal part is small. Residual fracture site distraction can lead to increased risk of delayed union/non-union with the need for additional procedures to obtain union.^[2] Conservative treatment modalities include hanging casts, coaptation splints, long-arm casts, shoulder spica casts, olecranon pin traction, U-slabs, and functional bracing.^[1,3]

Fractures of the shaft of humerus have been treated conservatively since ages with good result. Sir John Charnley⁴ in his treatise, 'The closed treatment of common fractures' state that it is perhaps one of the easiest major long bone fractures to be treated by conservative methods. The generally good outcomes with non-operative treatment may be due, in part, to tolerance of malunion in the arm.

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.^[4,5]

Usually, plate fixation is achieved by a dynamic compression plate (DCP), and it is generally accepted that this gives satisfactory results.^[6] Plate osteosynthesis has been described as gold standard for fixation of fracture shaft of Humerus by some authors with reported union rate of 95% to 97%.^[6,7] 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 fractures⁸ and osteoporotic bones.^[8,9]

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 but their use is complicated by iatrogenic comminution, torsional instability and shoulder impairment.^[10,11] 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.^[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.

Hence the dilemma to use which type of implant in fractures of the shaft of humerus continues in mind because of the relative advantages and disadvantages of both plating and nailing. The present study is intended to come out with some better understanding about the fixation modalities of fractures of shaft of 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. The fracture was classified as per A.O. classification. The affected limb was immobilized by U-slab till the time of surgery.

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

Initially the patient's injured arm was immobilized in a plaster of Paris U-slab, drugs were given to

alleviate pain. All the patients were taken for elective surgery as soon as possible after necessary blood, urine & radiographic pre-operative work-up. 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: The patient was taken up for surgery 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 centimeters, 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.

- Definitive nail position

Location of the proximal end of the nail under image intensification was done by inserting a K-wire, through the corresponding hole in the insertion handle. The proximal end of the nail was kept below the level of the articular cartilage.

- 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 \pm SD and it was checked for normality. As it was normally distributed data, 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.

RESULTS

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. In our study the male to

female ratio was 1.14:1. 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. [Table 1]

In our study 90% of the fractures were closed. Only 3 out of 30 cases (10%) were open fractures. There was 1 open fracture in nailing group and 2 in plating group. All the 3 fractures were of open grade I. [Table 2]

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. However, the commonest amongst these cases was type 12-B-2 (10 out of 30 cases). [Table 3]

In 7 cases (~23%) there was some associated injury. None of the associated injuries showed any common pattern. [Table 4]

ILN of 6mm diameter was most commonly used for fracture fixation in our study (10 out of 15 cases in ILN group).

Amongst 15 cases of plating group, Broad DCP and Narrow DCP were used in 6 and 9 cases respectively. Inter-fragmentary compression with lag screw was required in 4 cases along with plating (3 cases of Narrow DCP and only 1 case of Broad DCP).

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.

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.

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

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 1: Mode of injury

Mode of Injury		Type of Surgery		Total
		NAILING	PLATING	
Fall	No. of patients (%)	3(20.0%)	2(13.3%)	5(16.7%)
RTA	No. of patients (%)	12(80.0%)	13(86.7%)	25(83.3%)
	Total(%)	15(100.0%)	15(100.0%)	30(100.0%)

p value 1.000

Statistically Insignificant

Table 2: 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

Table 3: Type of Fracture

# TYPE (AO Classification)		Type of Surgery		Total
		NAILING	PLATING	
12-A-1	No. of patients (%)	4 (26.7%)	2 (13.3%)	6 (20.0%)
12-A-2	No. of patients (%)	2 (13.3%)	3 (20.0%)	5 (16.7%)
12-A-3	No. of patients (%)	3 (20.0%)	5 (33.3%)	8 (26.7%)
12-B-1	No. of patients (%)	1 (6.7%)	0 (.0%)	1 (3.3%)
12-B-2	No. of patients (%)	5 (33.3%)	5 (33.3%)	10 (33.3%)
	Total (%)	15 (100%)	15 (100%)	30 (100%)

p value 0.669 Statistically Insignificant

Table 4: Associated Injury

Associated Injury	No. of patients	Percentage
# BB L Leg	1	3.3
# Lat. 1/3rd R clavicle	1	3.3
Head Injury	1	3.3
IDK R Knee	1	3.3
Intertrochanteric# R Femur	1	3.3
Volar Barton# R	1	3.3
# L1 Vertebra	1	3.3
NO Associated Injury	23	76.7
Total	30	100

Table 5: Type of Surgery

Type of Surgery	No. of Patients	Percentage
Interlocking Nail	15	50%
Plating	15	50%
Total	30	100%

Table 6: Deformity at Fracture Site after Fixation

Deformity	No. Of Patients		
	Nailing	Plating	Total
(rotatory/angulatory)	01 (6.7%)	01(6.7%)	02 (6.7%)
No deformity	14 (93.3%)	14 (93.3%)	28 (93.3%)
Total	15 (100.0%)	15 (100.0%)	30 (100.0%)

Table 7: 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

DISCUSSION

ORIF with Plating and CRIF with Intramedullary Nailing are the two well accepted modalities of treatment.

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 al and Raghavendra et al.^[13,14]

Epidemiological study for fracture shaft humerus done by Ekholm et al,^[15] 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.^[16,17] However epidemiological study of Ekholm et al,^[15] showed female incidence of 61% and male incidence of 39%.

In our study Right humerus was involved more often. Other studies as Lin et al,^[18] Kesemenli et al,^[12] have also shown slight right side preponderance. However study done by Singiseti et al,^[19] had no obvious side predilection. However epidemiological study by Ekholm et al,^[15] showed fractures on Left side in 52% of cases and on Right side in 48%.

In our study 25 cases (~83%) sustained injuries in road traffic accidents [12 in ILN group and 13 in Plating group]. Remaining 5 cases (~17%) sustained injury from fall on ground [3 in ILN group and 2 in Plating group]. This is comparable to almost all the reported studies as Kesemenli et al,^[20] Chapman et al,^[16] Changulani et al.^[17]

However the epidemiological study of Ekholm et al,^[15] showed simple fall as mode of injury in 68% cases, 2nd being fall from height (8%) followed by sports related (7%), traffic related (5%) and miscellaneous causes (12%).

In this series the commonest fracture type was B2 (bending wedge fracture). The second most common was type A3 (simple transverse fracture). But overall Type A was more common (19 cases).

Most of the studies showed the commonest type to be type A which is comparable with our study.^[14,20] But individually, type A3 was the most common type in most of the studies.

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 al,^[13] and Raghavendra et al.^[14] In the epidemiological study of Ekholm et al,^[15] incidence of open fractures was 2%.

In our study 7 (23%) patients had some associated injury. Out of these 3 were in nailing group and 4 in plating group. In the nailing group one had #BB leg, one had I/T Femur #, and one had volar barton #. In the plating group one had head injury, one had #lat. 1/3rd clavicle, one had ACL Tear, and one had compression# L1 vertebra. All the injuries were managed accordingly.

The incidence of associated injuries is comparable to the studies Raghavendra et al,^[14] Changulani et al.^[16]

In our study mean operative time was almost equal in both the groups. Mean operative time for nailing and plating in our study was 70 ± 13.63 min (range 50-90) and 69.33 ± 12.23 min (range 60-90) respectively. In the plating group it was the soft tissue dissection which contributed more to the operative time whereas, in the nailing group attempts of closed reduction and distal free hand locking contributed more to the operative time.

In the studies of McCoarmack et al,^[13] and Chao et al,^[21] the mean operative time for both the groups

was almost equal but was higher in comparison to our study.

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.²¹ Duration of hospital stay was almost equal with both the treatment modalities.

Of the 15 patients in nailing group 11 fractures united with mean union time of 15.27 ± 6.21 weeks while 4 cases did not unite. In plating group out of 15 cases 13 united with mean union time of 15.23 ± 3.32 weeks while 2 cases did not unite. In the study of Singiseti et al,^[19] 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 al,^[14] showed mean union time of 8-10 weeks for both nailing and plating groups.

CONCLUSION

Overall plating is a better procedure than interlocking nail for fracture shaft humerus. Nailing to be done only when plating cannot be done especially segmental #, pathological #, severe multiple trauma for DCO. Plating in upper half can be done without radial n. exploration but in lower half nerve should preferably be explored and handled gently. Nailing can be preferred in females because of aesthetics of smaller scars in the arm.

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