



COMPARATIVE STUDY OF FUNCTIONAL OUTCOME OF DYNAMIC COMPRESSION PLATING WITH INTRAMEDULLARY INTERLOCKING NAILING IN CLOSE FRACTURE SHAFT OF HUMERUS IN ADULTS

Orthopaedics

Dr. Hemeshwar Harshwardhan

Professor & Head, Department of Orthopaedics, JLN Medical College, Ajmer

Dr. Vishal Tulsani

III year Resident, Department of Orthopaedics, JLN Medical College, Ajmer

Dr Sumer Singh

Assistant Professor, Department of Orthopaedics, JLN Medical College, Ajmer.

Dr Umesh Samaria

Assistant Professor, Department of Orthopaedics, JLN Medical College, Ajmer.

ABSTRACT

Background and objective: To compare the results of dynamic compression plating and intramedullary interlocking nailing in treatment of closed fracture shaft humerus in adults with reference to study Functional outcome, Rate of healing, Complications between two groups. **Methods:** 38 adult patients with closed fracture shaft humerus were randomly assigned in to two groups after informed consent. Both groups were investigated in usual manner. Group A (ILN group) with 20 patients were treated with intramedullary interlocking nailing and group B (DCP group) with 18 patients were treated with Dynamic compression plating. The patients were followed up every four weeks till radiological union was seen. Disabilities of Arm, Shoulder and Hand" (DASH) Questionnaire was used for functional outcome measurement. **Results:** Time taken for radiological healing is more in DCP group but it was statistically not significant. According to DASH score functional outcome assessment more excellent result found in DCP group than ILN group. Postoperative complication rate is higher in ILN group which was statistically significant. **Conclusion:** Both dynamic compression plating and interlocking nailing are good with respect to union of the fracture but with respect to the functional outcome and rate of complications, we are of the opinion that dynamic compression plating offers better result than interlocking nailing.

KEYWORDS

Humerus shaft fracture, interlocking nailing, dynamic compression plating, DASH Score

INTRODUCTION

Fractures of the humeral shaft are common and accounts for 1% of all fractures. Fractures of humeral shaft have traditionally been regarded benign, with high percentage of primary healing with conservative methods, using either a hanging arm cast or a functional brace. However loss of reduction in the plaster cast invariably leads to malunion. Operative treatment for humerus fractures has usually been reserved for the treatment of nonunion, associated with fractures of forearm, for poly trauma patients, and for those with neuro-vascular complications. The advantages of operative management are early mobilization and patient comfort. But, operative management carries the risk of technical errors and post operative complications infections, nerve injuries etc. Most of the studies have used fracture union as the major determinant of the outcome and very few studies have examined the functions at the shoulder and elbow.

The optimal method of humeral shaft fracture fixation remains in debate. Two techniques under study include intramedullary nailing and dynamic compression plate fixation. Plating provides satisfactory results but requires extensive dissection, and meticulous radial nerve protection. The plate may fail in osteoporotic bone. With the dynamic success of intramedullary fixation of fractures of the femur and tibia, there was speculation that intramedullary nailing might be more appropriate for humeral shaft fractures than dynamic compression plating.

The theoretical advantage of intramedullary nailing included less invasive surgery, an undisturbed fracture hematoma and use of a load sharing device support. However, the phenomenon success of interlocking nailing in long bones like femur and tibia is not seen in humerus. According to recent studies the preferred method of fixation of humeral fractures is by dynamic compression plate.

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 and to analyse statistically significant difference in the results of these two methods.

MATERIAL AND METHODS

After approval from ethical committee 48 patients of fracture shaft humerus were enrolled in the study of age 18 and above. They were randomly divided into two groups.

ILN = Patients operated with Interlocking nailing (n=20)

DCP = Patients operated with Dynamic Compression Plating (n= 18)

Inclusion Criteria

- Age 18 and above of both sex
- Only the diaphyseal humeral fractures.

Exclusion Criteria

- Fracture of epiphyseal and metaphyseal region of humerus
- Patients treated conservatively for other medical reasons.
- Patients treated with any other modality
- Open fractures. Pathological fractures.
- Patients who were lost to follow up or died before the fracture union.

Primary Requirements

Written informed consent was taken.

A thorough history and clinical examination was done. Neurovascular status was noted specially for radial nerve. Roentgenogram of the arm with shoulder and elbow was taken in both antero- posterior and lateral views. Additional roentgenograms were taken if any other injury was suspected. The humeral shaft fracture was temporarily immobilized with a U-slab and arm pouch.

Preoperative Evaluation

Pre-operative planning and investigations were done and the patients were posted for open reduction and internal fixation with DCP or interlocking nailing.

Approaches for Procedure

- For DCP Anterolateral approach was used in patients with fractures of the upper and middle thirds of the shaft of the humerus (4 patients). Posterior approach was used in patients with fractures of the lower thirds of the shaft (14 patients).
- Only antegrade nailing was done in case of interlocking nailing group, none of the cases were treated by retrograde nailing.

Materials used

- For DCP: 4.5 mm narrow DCP with screws
- FOR ILN: 7, 7.5, 8 mm nail with bolts of appropriate length
- 8 patients was lost to follow up and 2 patients were excluded from the study as they expired leaving us with 38 patients, 18 were fixed with DCP and 20 were fixed by interlocking nail.

Follow Up And Criteria For Follow Up

The patients were followed up every 2 weeks till radiological union was seen. At every follow up clinical examination was done to assess status of the surgical wound, pain, tenderness, range of motion of shoulder and elbow, stability of the fracture and clinical union.

Roentgenograms were taken in AP and Lateral views to look for signs of radiological union. The union is confirmed radiologically when plain X-ray showed bone trabeculae or cortical bone crossing fracture site on at least three surfaces on orthogonal radiograms. Clinical union when fracture site become pain free and stable

The functional outcome was measured by the "Disabilities of Arm, Shoulder and Hand" (DASH) Questionnaire at nine months or at full recovery whichever was earlier.

The DASH questionnaire has thirty questions the answers of which are graded from one to five points. The functional score is calculated by the formula

DASH DISABILITY / SYMPTOM SCORE = $\{(\text{sum of } n \text{ responses}) - 1\} \times 25 / N$

- Where „N”= number of responses.
- The best possible score is „0” and the worst possible score is „100”. The functional outcome decreases as the score increases.

The result was then graded as Excellent, Good, Fair and poor as follows [4]

- Excellent – 0 to 20 Points
- Good – 21 to 40 points
- Fair – 41 to 60 points
- Poor – Greater than 60 points

The time taken for radiological union and the functional outcome in both groups were then compared.

RESULTS

Total 38(100%) study subjects comprises of DCP GROUP 18(47%) and Interlocking nailing 20(53%). Average time taken for surgery was 82 minutes for DCP and 70 minutes interlocking nailing group. The average duration of follow up in our study was 10.30 months. Range (6 to 14 months). Average time taken for radiological healing in the interlocking group was 14.05 weeks and 16.06 weeks in DCP. So the healing rate was relatively faster in the interlocking group as compared to the DCP group. There was no statistically significant difference in the time taken for radiological union. $P = 0.061$. 2 fracture treated with DCP remained ununited.

Table 1: Sex of The Patient

Sex	ILN Group	DCP Group	Total
F	6(30%)	5(27.8%)	11(28.9%)
M	14(70%)	13(72.2%)	27(71.1%)
Total	20(100%)	18(100%)	38(100%)

Chi sq. = 0.023 p value = 0.880

Sex of the patient related to incidence of shaft humerus fracture is statistically non-significant. (Table 1)

Table 2: Age of patients

Group	N	Mean	Std.Deviation	
ILN	20	35.05	11.44	t value=0.60 p=0.54
DCP	18	37.28	11.18	

Age of the patient related to incidence of shaft humerus fracture was statistically non-significant. (Table 2)

Table 3: Mode of injury

Mode of injury	ILN Group	DCP Group	Total
Domestic	1(5%)	2(11.1%)	3(7.9%)
Fall	3(15%)	4(22.2%)	7(18.4%)
RTA	16(80%)	11(61.1%)	27(71.1%)
Sports injury	0(0%)	1(5.6%)	1(2.6%)
Total	20(100%)	18(100%)	38(100%)

Chi = 2.69 p = 0.44

RTA is major cause of fracture shaft humerus in adults (Table 3)

Table 4: Time taken for radiological healing

Groups	No	mean	Std. Deviation	
ILN	20	14.05	3.18	t=1.903 p = 0.065
DCP	18	16.06	3.10	

Time taken for radiological healing is statistically non-significant in both groups. (Table 4)

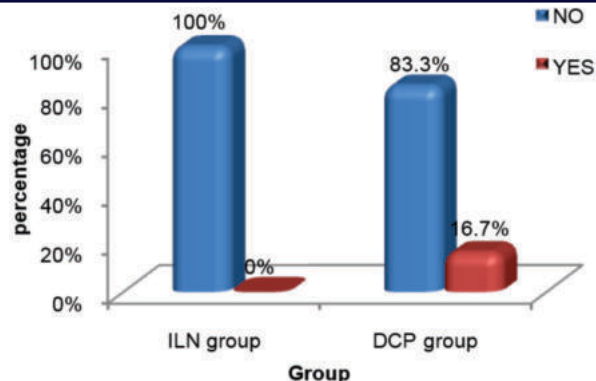


Fig 1: Details of Radial nerve palsy

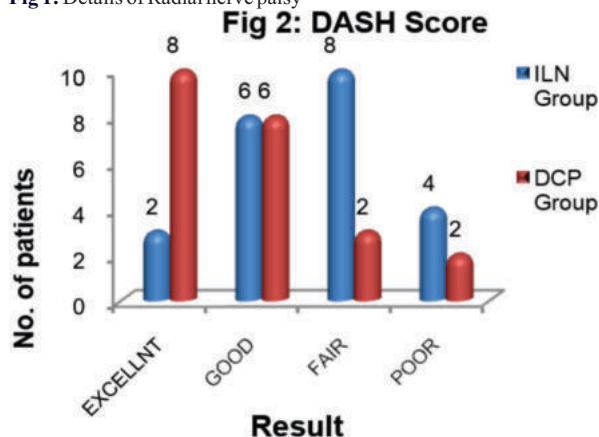


Fig 2: DASH Score

Chi = 8.284 p = 0.04

Excellent results more found in DCP group. Functional outcome with dash score assessment is statistically significant.

Fig 3: Post-operative complications

Chi = 13.02 p = 0.04

Postoperatively in the DCP group there were 13 complications and in the interlocking group there were 6 cases with complications. Complications were more in the interlocking group, which was statistically significant ($p = 0.009$).

DISCUSSION AND RECOMMENDATION

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 for fractures of the humeral shaft. Plate osteosynthesis requires extensive soft tissue dissection with the risk of radial nerve damage.

The indications for open reduction and internal fixation of acute fractures of the humeral shaft have been described as: fractures in patients with multiple injuries, open fractures, fractures associated with vascular or neural injuries or with lesions of the shoulder, elbow or forearm in the same limb; bilateral upper extremity injuries, fractures for which closed methods of treatment have failed and pathological fractures. In several reported series, the presence of associated multiple injuries was the most frequent indication for internal fixation of the humeral shaft. In our study failed closed reduction and associated injuries were the most common indications.

This study is having a short term follow up of minimum of 6 months and maximum of 17 months (mean 11.44 months) and therefore discussion is essentially a preliminary assessment.

In previous reports the incidence of non-union after plating has ranged from 2% to 4%. In our DCP group the incidence of non-union is 11.11%. Retrospective studies of locked intramedullary nail fixation quote incidences of non-union ranging from 0% to 8%. In our series the incidence of non-union in the interlocking nail group is 0%.

The incidence of radial nerve palsy with fracture shaft humerus varies from 6% to 15%. In our series the incidence was 7.9%. Out of the 3 cases, 2 cases recovered (66.6%), which tallied with Seddon's and Pollock's series of 70% and 68% respectively.

In the DCP group the incidence of post operative radial nerve palsy is 2% to 5% but there were no such cases in our study. Which was same in the case of the interlocking group. The incidence of post operative radial nerve palsy in various studies varies from 2.6% to 14.3% in the interlocking group.

There was no problem with infection in our patients with only 1 patient having superficial infection (2.63%) among 38 patients, which responded well to debridement and intravenous antibiotics for 3 weeks. The failure of fixation in a case of DCP was due to poor technique due to inadequate hold. When this fracture was replated with the addition of 2 extra holes and bone graft, the fracture united at 6 months without complications. The patient with implant failure in interlocking group went on to unite uneventfully despite the screw breakage at one of the two distal interlocking sites. The rate of intra operative comminution during interlocking nail insertion with various studies varied from 7.7% to 10%. In our series there were 2 (10%) intra operative comminutions out of 20 patients treated with interlocking nailing. One occurred at fracture site due to hoop stress and the other at the greater tuberosity during nail insertion. Persistent pain after antegrade nailing is common. Habernek and Orthner in 1991 reported good results with Seidel's interlocking nail but later withdrew their support in 1998, as they had not assessed the shoulder functions of their patients properly. The cause of pain could be disruption of the rotator cuff in its avascular zone within 1 cm of its insertion to the greater tuberosity that may lead to poor healing.

3 patients had developed shoulder pain/stiffness and 11 of our 20 patients in the interlocking nailing group reported some or the other shoulder pain. Our study confirms that antegrade insertion of nail can lead to problems with shoulder function and range of movement probably because of damage to the rotator cuff.

The sample size of our study is small with only 38 patients included in the final study. The union rates are comparable in both the groups with the results in excellent and good category are similar (p value insignificant). There were more fair and poor results in the interlocking nailing group compared to DCP group. The complications were more in the interlocking nailing group with most of them pertaining to poor shoulder function or pain and this difference in the complications was statistically significant.

Though interlocking intramedullary nailing is good for specific conditions like pathological fractures, segmental fractures or with associated lower limb fractures which require early weight bearing with crutch walking, we still consider DCP fixation is better than interlocking nailing in treating fractures of the diaphysis of the humerus.

CONCLUSION

The fracture shaft of humerus includes 1% of all fractures. Treatment modalities has to be decided carefully with type of fracture, among various surgical treatment modalities Dynamic compression plating and Interlocking nailing are most commonly used by surgeons. With respect to union rate both techniques are good but there is higher complication rate in ILN group especially considering pain and function of shoulder joint. So we finally conclude that Dynamic compression plating is preferable technique than interlocking nailing for fracture shaft of humerus in adults. The fallacies in our study are, the sample size is small and we have not taken retrograde nailing in consideration.

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