

A COMPARATIVE STUDY OF FUNCTIONAL OUTCOMES OF FRACTURE SHAFT HUMERUS IN ADULTS TREATED WITH DYNAMIC COMPRESSION PLATING AND INTERLOCKING NAILING

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ABSTRACT: INTRODUCTION: Optimal method of humeral shaft fracture fixation remains in debate till date. 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. Theoretical advantage of intramedullary nailing included less invasive surgery, undisturbed fracture hematoma and use of load sharing device support. Purpose of this study is to compare outcomes of each method of fixation for fracture shaft of humerus. **MATERIALS AND METHODS:** Patients with diaphyseal fractures of the humerus were divided in two groups of 20 treated with dynamic compression plate or with intramedullary interlocking nail. Postoperatively both groups received same type of physiotherapy. They were followed up regularly. Time taken for radiological union in two groups was compared. After satisfactory radiological union, functional outcome was assessed by "Disabilities of Hand, Shoulder and Elbow (DASH) Questionnaire". **RESULTS:** Functional outcome was better in DCP group compared to interlocking nailing group which was statistically significant ($P= 0.062$). Rate of healing was marginally better in DCP group as compared to I.M nail. **CONCLUSION:** We are of opinion that when surgery is opted as a choice of treatment, both modalities of treatment i.e. dynamic compression plating and interlocking nailing are good as far as union of fracture is concerned, but considering number of complications and functional outcome, we opine that dynamic compression plating offers better result than antegrade interlocking nailing with respect to pain and function of shoulder joint.

KEYWORDS: Humerus, Diaphyseal humerus fracture, Fracture, Dynamic compression plate, Interlocking nail, Disabilities of Hand, Shoulder and Elbow (DASH) questionnaire.

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.¹ However loss of reduction in the plaster cast invariably leads to malunion. 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

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compression plate fixation. Plating provides satisfactory results but requires extensive dissection, and meticulous radial nerve protection.² 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.³ However, the phenomenal 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 functional outcomes of each method of fixation (dynamic compression plating and interlocking nailing) for the fracture shaft of humerus and to analyze statistically significant difference in the results of these two methods.

AIMS AND OBJECTIVES: To compare the results of compression plating and interlocking nailing in the treatment of fracture shaft of humerus with reference to Functional outcome, Rate of healing and Complications.

MATERIAL AND METHOD: All patients with fractures of shaft of humerus that met the criteria for operative interventions (intramedullary interlocking nailing and dynamic compression plating) presenting to the department of Orthopaedics, were included in the study. A total of 40 patients, 20 in each group were enrolled excluding patients with Gustilo-Anderson grade II and III open fractures shaft of humerus, periarticular fractures of humerus, fractures with associated neurovascular injury, bone and joint disease, primary nerve palsy, patient's not willing and pathological fractures. A thorough history and clinical examination was done. The status of radial nerve injury was recorded. 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. The 40 humeri of these 40 patients were prospectively randomized into two categories of dynamic compression plating or interlocking nailing. Once the patients were randomized, pre-operative planning and investigations were done and the patients were posted for open reduction and internal fixation with DCP or closed reduction and internal fixation with interlocking nailing. Anterolateral approach was used in patients with fractures of the shaft of the humerus. Only antegrade nailing was done in case of interlocking nailing group, none of the cases were treated by retrograde nailing. In the first group, 4.5 mm narrow DCP was used, and in second group standard intramedullary interlocking nail was used. Post operatively a compression bandage was applied and a broad arm pouch was given. Parenteral antibiotics were given for a period of 5 days. Wound is inspected on the 2, 5, 7, 11 post-operative day. Sutures were removed between the 11th and 14th post-operative days. Patients were followed up on 6th week, 10th week, 14th week and 24th week and assessed for pain at the fracture site, evidence of union, functional outcome using DASH score. If there are no radiological signs of union by 16-18 weeks, the fracture was categorized as delayed union and if absence of fracture union after 32 weeks after injury was categorized as non-union. Proportion, measure tendency and dispersion of the

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variables like age, sex, involved limb, type of fracture, time to achieve union, functional outcome of shoulder and elbow, complications of surgery were tested by appropriate parametric and non-parametric statistical technique (t-test and Chi-square test) depending upon the natures of variables in both the groups. Outcomes were compared between two groups and both the magnitude and significance of difference was measured using appropriate tests. The results were compared with other relevant studies in the literature.

INTRAMEDULLARY INTERLOCKING NAILING PROCEDURE: Patients were placed in the beach chair position, with affected arm draped free. The image Intensifier is brought in directly laterally on the injured side and the patient is brought on the edge of the table. It is important to check and ensure a good X- ray of the entire humerus. A small incision was made at the anterolateral corner of the acromion, the deltoid was split. The supraspinatus tendon was identified, and split for 1-2 cm in line with its fibres. The entry point was in greater tuberosity, just lateral to the articular margin. Entry was made using bone awl, guide wire inserted and then reamer placed over guide wire. Reaming was done and then inserted nail 1 mm smaller in diameter than last reamer used. The length of nail was carefully chosen and put in the medullary cavity. The nail was then locked with screws using zig proximally and free hand technique distally. Any split in rotator cuff was repaired, incision was closed in layers. Standard dressing was applied and placed in broad arm pouch.

OPEN REDUCTION AND INTERNAL FIXATION WITH DYNAMIC COMPRESSION PLATE: All the Fractures in proximal and middle third are approached through an anterolateral incision. After the humerus is exposed and the radial nerve retracted, the fracture is reduced and the plate is placed on the bone such that the appropriate part of the plate is on the fracture site. That is the middle segment of the DCP plate without holes. Transverse fractures are fixed in compression mode and oblique fractures are fixed in neutralization mode with a lag screw across the fracture site through the plate or separately. Post operatively a compression bandage was applied and a broad arm pouch was given.

AFTER TREATMENT: The importance of rehabilitation can be aptly summarized by the much quoted and timeless words of the AO group "Life is Movement, Movement is Life". Whenever anatomical reduction is achieved and bone stock is good motion of the shoulder and elbow should be begun as soon as pain permits. Some situations like marked comminution and poor bone stock need protection by a POP splint.

POST-OPERATIVE REHABILITATION:

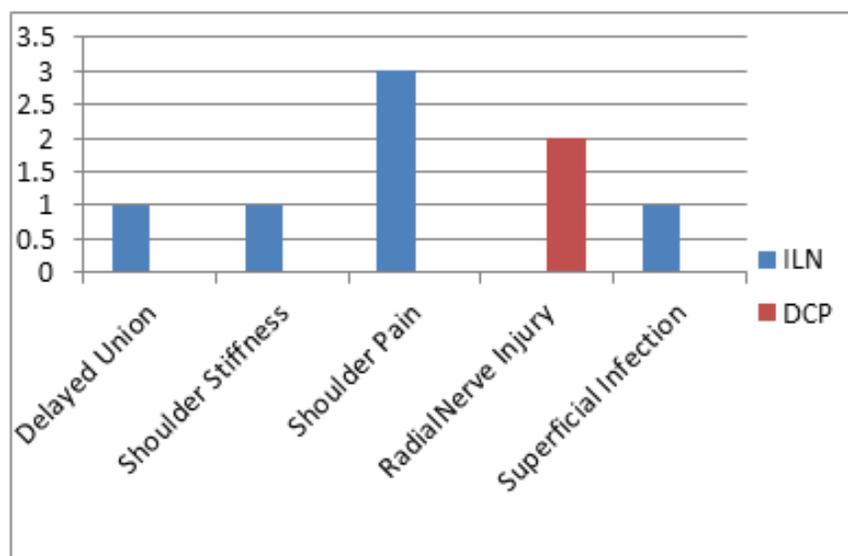
DYNAMIC COMPRESSION PLATING: Post-operative rehabilitation following stable osteosynthesis by plate is straight forward. We start the patient with finger and wrist movements on the 1st post-operative day. Mobilization begins on post-operative day 2 with active-assisted elbow flexion-extension and forearm pronation-supination exercises taking into consideration pain tolerated by the patient. After that if patient is able to tolerate the pain then we start the patient on pendulum exercises of shoulder from post op day 5. Then as the tolerance increases we start

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the patient with shoulder shrugs and shoulder circling exercises followed up by shoulder abduction stretching exercises. Resistive exercises and load bearing are started only after evidence of bridging callus on radiograph. Thus a good functional range of motion is achieved within 4-5 weeks.

INTRAMEDULLARY NAILING: In case of IM Nailing the post op rehabilitation protocol depends on the stability of fixation and configuration of fracture. For a stable fixation the arm is placed in a sling or shoulder immobilizer at end of surgery. Finger and wrist exercises are started on the 1st post-operative day. Then from post-operative day 2 we start with elbow exercises and forearm pronation-supination exercises. Then on post op day 5 we start with pendulum exercises of shoulder. Then as tolerance to pain increases we start with assisted abduction exercises of shoulder. Rotational movements of shoulder against resistance and load bearing exercises are avoided until evidence of bridging callus is seen on radiograph. Thus a good functional range of motion is thus achieved by 5-6 weeks.

OBSERVATION AND RESULTS: In our study there were more males (26) as compared to females in both nailing and plating group. The mean age was 33.6 years for nail group and 37.9 in plate group. Road traffic accident was the most common mode of injury and most of the patients were right handed. The immediate immobilization technique used was U-slab application in both the groups. Postoperative hospital stay was similar in both groups with mean stay was 4.5 days.

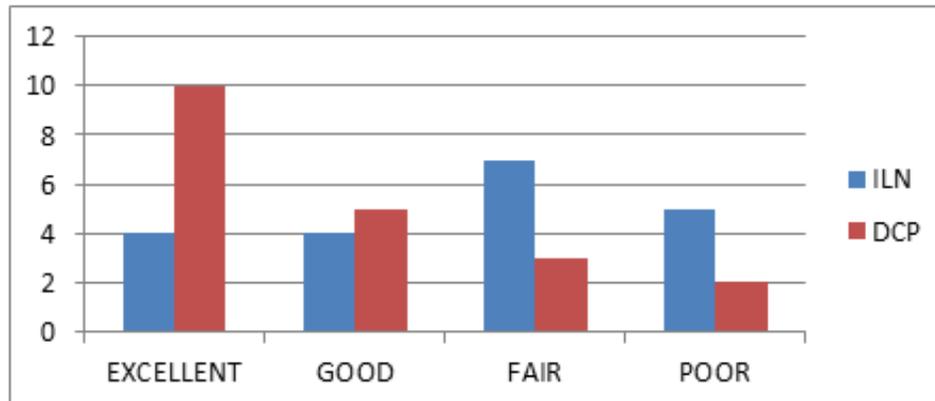


Graph 1: shows the post-operative complications in both the groups

The post-operative radial nerve palsy was seen in 2 cases treated by DCP. There were no significant difference in post-operative infection at second week in both the groups and no evidence of infection on subsequent follow up. There was no significant difference in pain in both the groups. Dash score gradually improved in both nail and plate group but Dash score was

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significantly higher in nailing group at follow up. Four patients had stiffness of shoulder in nailing group. This shows better functional outcome in plating group. Average time taken for radiological healing was 17.62 weeks. In the interlocking group 18.05 and DCP to 17.4. So the healing rate was relatively faster in the DCP group as compared to the interlocking group. There was no statistically significant difference in the time taken for radiological union ($P = 0.2339$). The average DASH score of the whole series was 33.82 (Lower the DASH score better the function). The average DASH score in the DCP group was 24.95 and in the interlocking group it was 44.4. The results were statistically significant with p value of 0.062.



Graph 2: shows the comparison of DASH score of both groups

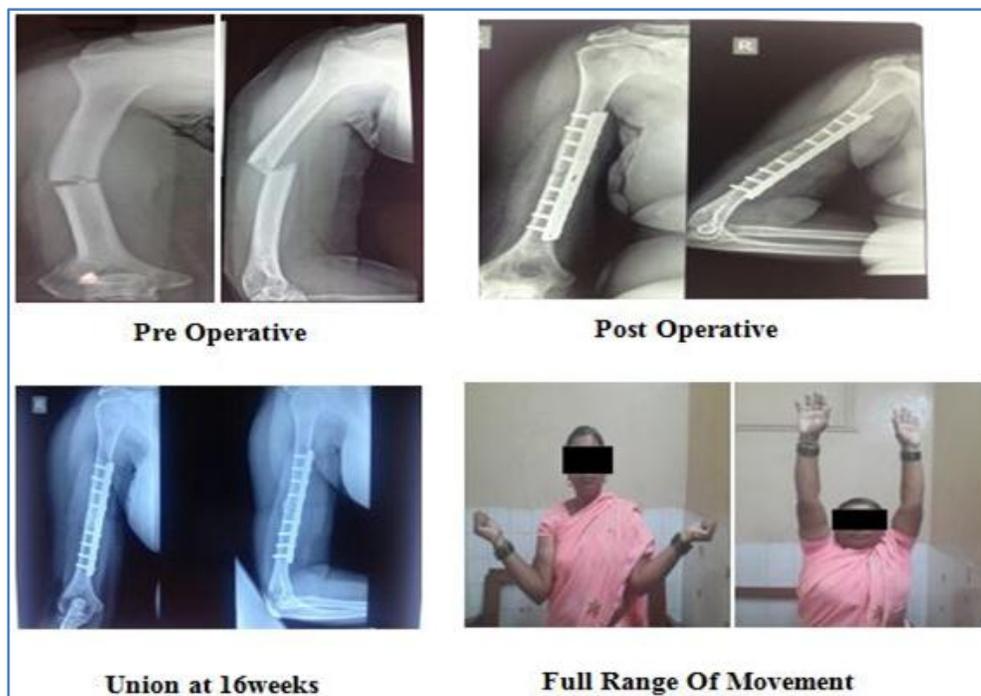


Fig. 1: Case treated with DCP and follow up

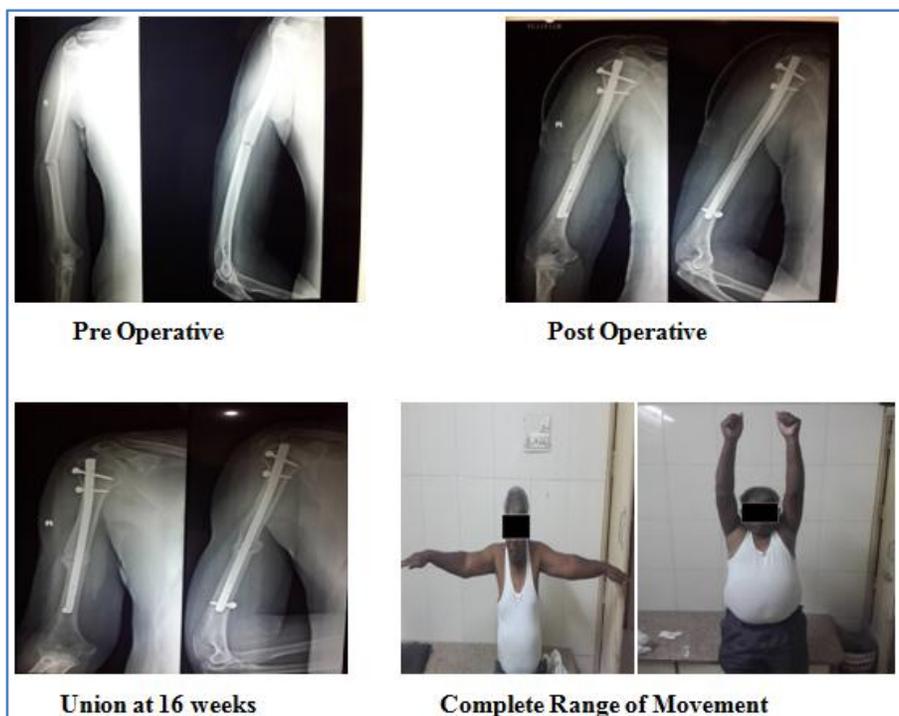


Fig. 2: Case treated with I.M Nail and follow up

DISCUSSION: 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.⁴ 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 fractures⁵. 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. In a study carried out by Amit Putti et al⁶ he reported a mean time of healing of 16 weeks in patients with DCP plating and 18 weeks in patients treated with nailing. In our study we achieved a mean healing time of 18.05 in patients treated with humerus nailing and 17.4 weeks in patients treated with DCP plating. In previous reports the incidence of non-union after plating has ranged from 2% to 4%.⁷ In our study there is no incidence of non-union. Retrospective studies of locked intramedullary nail fixation quote incidences of non-union ranging from 0% to 8%.⁸ We had a single case of delayed union in the Intramedullary nailing group but it progressed to union by 22 weeks without intervention. The incidence of post op radial nerve palsy with fracture shaft humerus varies from 6% to 15%.⁹ In our series the incidence was 6.66% and both cases recovered completely. Dabezies EJ et al in his study found that in the DCP group the

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incidence of post-operative radial nerve palsy is 2% to 5%¹⁰, and there were 2 cases in our study. The incidence of post-operative radial nerve palsy in various studies varies from 2.6% to 14.3% in the interlocking group.¹¹ In our study there are no such case of the radial nerve palsy in interlocking group. There was no problem with infection in our patients with only 1 patient having superficial infection among 40 patients, which responded well to debridement and intravenous antibiotics for 3 weeks. There were no cases of failure of fixation in our study. The rate of intra operative communiton during interlocking nail insertion with various studies varied from 7.7% to 10%.⁴ In our series there was 1 intra operative communitons out of 20 patients treated with interlocking nailing. In cases of humerus fractures treated operatively by IM nailing the most common problem in post-operative period is restricted abduction movement at shoulder. In our study we found that following the rehabilitation/mobilization plan our patients were able to achieve a good functional range of motion at elbow in 2-4 weeks where as we had 70° abduction at shoulder by 4-5 weeks and 90° abduction by 5-6 weeks. In cases of patients treated with DCP we achieved a good functional range of motion at elbow in 2-4 weeks and shoulder in 4-5 weeks except in 2 cases where we started guarded mobilization considering the fixation and quality of bone. Habernek and Orthnerin¹² 1991 reported good results with interlocking nail but Persistent pain after antegrade nailing was common and so later they withdrew their support in 1998, as they had not assessed the shoulder functions of their patients properly. 4 patients had developed shoulder pain/stiffness in the interlocking nailing group in our study. 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.¹³ 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 union rates are comparable in both the groups with DCP group having more results in excellent while in good category results 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. The overall functional outcome in our study is better for the DCP group (24.95) as compared to Interlocking Nailing group (44.4) and this difference when compared is statistically significant (p value – 0.0062). 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: Fractures of the shaft humerus are one of the common fractures affecting present generation and treatment modality has to be decided carefully. We are of the opinion that the operative treatment of the humerus fractures should be done in patients with poly trauma and in patients with failed conservative treatment. Both the modalities of treatment i.e. dynamic compression plating and interlocking nailing are good as far as union of the fracture is concerned, but considering the functional outcome and rate of complications, we are of the opinion that dynamic compression plating offers better result than interlocking nailing with respect to pain and function of the shoulder joint. We therefore conclude that in cases where both dynamic compression plating and interlocking nailing can be done, we would prefer to use

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dynamic compression plating, as the results are better than interlocking nailing. The fallacies in our study are, the sample size is small and we have not taken retrograde interlocking nailing in to consideration.

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