ISSN 2515-8260 Volume 09, Issue 07, 2022

A COMPARATIVE PROSPECTIVE STUDY OF HUMERUS SHAFT FRACTURE MANAGED BY PLATING VERSUS INTERLOCKING INTRAMEDULLARY NAILING

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ABSTRACT

Introduction: Fractures of humerus are no exception. Fractures of the humeral diaphysis constitute 3% of all fractures. It is the most challenging fracture of upper limb to be treated. Severe damages can occur if fractures are not evaluated and treated properly. The humerus is enveloped by a sleeve of muscles and has rich blood supply which helps in fracture union. As the limb does not take part in weight bearing or ambulation, some amount of shortening is functionally acceptable. But rotational deformity is not tolerated well.Traditionally humerus shaft fractures have been managed with hanging cast or brace.

In modern day Open reduction and internal fixation with plate osteosynthesis has been a standard treatment for fractures of the humeral diaphysis but has the disadvantage of extensive dissection and excessive periosteal stripping, increased chances of infection or nerve damage, risk of mechanical failure in osteoporotic bone in old age. Further there is a stress shielding of bone by the plate and reduced strength of union due to primary bone healing compared to the callus healing seen in biological fixation with intramedullary nailing. Intramedullary interlocking nail is a better implant biomechanically. Nails are exposed to lesser bending force and act as a load sharing and stress shielding devices.

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Results

The average time taken for union is 13.2 weeks and 14.2 weeks for plating and nailing respectively. There were 2 case (13.33%) of non union among the plating group and no non union was seen among the nailing group .

Conclusion

From our study we conclude that both intramedullary nailing and plating are good as far as the union of the fracture, time to achieve union and functional outcome is concerned, but complications were found to be more in plating group. Neither plating nor nailing is superior in all circumstances for a particular fracture and each case has to be individualised.

INTRODUCTION

In the present era, trauma is the leading cause of mortality and morbidity and is on a constant rise. The victims of bony injuries face several hindrances like prolonged immobilization, loss of income and difficulties in their personal and family lives. Besides, the patients are often forced to live with complications like stiff joints and functional disability. Early restoration of joint motion, return to the normal physiologic function and minimal morbidity would be the ideal goal while fixing any fractured bone.

Fractures of humerus are no exception.Fractures of the humeral diaphysis constitute 3% of all fractures[1]. It is the most challenging fracture of upper limb to be treated. Severe damages can occur if fractures are not evaluated and treated properly. The uniqueness of anatomy, the fracture configuration and the functional significance of the region influences the treatment options. The humerus is enveloped by a sleeve of muscles and has rich blood supply which helps in fracture union. As the limb does not take part in weight bearing or ambulation, some amount of shortening is functionally acceptable. But rotational deformity is not tolerated well. Due to these inherent advantages of the region, conservative management often results in a very gratifying outcome.

Traditionally humerus shaft fractures have been managed with hanging cast or brace. Sarmento et al reported use of plastic sleeve with early return to functional activity. The average proportion of humeral fractures being treated conservatively reportedly varies from 33%2 to 95%.3 Sir John Charnley[2] in his thesis, "The closed treatment of common fractures" states, "it is perhaps one of the easiest major long bone fractures, to be treated by conservative methods". Different conservative methods include Coaptation splint, Velpaeau bandage, hanging arm cast and functional bracing. However, nonoperative treatment has its own disadvantages like the need for constant co-operation and repeated hospital visits, prolonged immobilization in cast or brace which sometimes may be required as long as 6 months, resulting in huge morbidity. However, all humerus fractures cannot be treated conservatively.

Surgical management is indicated in certain situations, its indications can be divided into:

1.Fracture indications

a) Failure to obtain and maintain adequate closed reduction.

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- Shortening greater than 3centimeter.
- Rotation greater than 30 degrees.
- Angulation greater than 20 degrees.
- Segmental fractures

b) Pathologic fractures.

c) Intra-articular extension.

1. Shoulder joint
2. Elbow joint.

2. **Associated injuries.**

a) Open wound.

b) Vascular injury.

c) Brachial plexus injury.

d) Ipsilateral forearm fractures.

e) Bilateral humeral fractures.

Surgical options include
Plate osteosynthesis
Intramedullary nailing
External fixation

Open reduction and internal fixation with plate osteosynthesis has been a standard treatment for fractures of the humeral diaphysis. Plate osteosynthesis gives good rates of fracture union with anatomical reduction and good compression across fracture site, with no damage to the rotator cuff and the elbow joint, but has the disadvantage of extensive dissection and excessive periosteal stripping, increased chances of infection or nerve damage, risk of mechanical failure in osteoporotic bone in old age. Further there is a stress shielding of bone by the plate and reduced strength of union due to primary bone healing compared to the callus healing seen in biological fixation with intramedullary nailing.
Intramedullary interlocking nail is a better implant biomechanically. Nails are exposed to lesser bending force and act as a load sharing and stress shielding devices. Cortical osteopenia that occurs right adjacent to ends of plates is rarely found. Thus chances of re-fracture after implant removal is seldom seen. Closed interlocking nailing involves minimal surgical intervention, biological fixation, no periosteal stripping. It also provides both rotational and torsional stability and preservation of hematoma. With the use of mobile C-ARM fluoroscopy this procedure has become easy to perform.

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The procedure of intramedullary nailing is usually indicated in patients with polytrauma, poor skin conditions, patients with osteoporotic bones, pathological fractures and in segmental

Fractures. With the advent of interlocking nail system indications have become wider and now is also used in shaft of humerus fracture with severe communition or bone loss. This procedure allows early mobilization .However it has a disadvantage of rotator cuff impingement and restricted elbow movements. There is also concern of medullary circulation, fat embolism and complications arising from application of incorrect technique.

The optimal method of humeral shaft fracture fixation remains in debate So, a study was undertaken to compare the outcomes of each method of fixation (plating and interlocking nailing) for, the fracture shaft of humerus and to analyse differences in the results of these two methods in terms of fracture union rate, functional outcome and complications.

AIMS AND OBJECTIVES

The aim of this study is to compare the results of the interlocking intramedullary nailing and plate osteosynthesis for the treatment of humeral shaft fractures in terms of

i) Time to achieve union

ii) Functional outcome(DASH score)

iii) Radiological outcome

iv) Complications of surgery.

v) To compare the outcome of our study with the previous studies.

MATERIALS AND METHODS

A prospective comparative study of 30 patients with humeral shaft fractures treated with Intramedullary interlocking nailing and Plate osteosynthesis undertaken in the Department of Orthopedics, Adichunchanagiri Hospital and Research Centre B.G Nagara, from December 2019 to June 2021. Of the 30 patients 15 patients underwent plating and 15 patients underwent nailing.

SOURCE OF DATA Patients admitted at Department of Orthopedics, Adichunchanagiri Hospital and Research Centre B.G Nagara.(Parent Institute).Follow up in outpatient Department. This study will be conducted on in-patient basis, meeting the inclusion and exclusion criteria.

STUDY PERIOD : 18 months (December 2019 to June 2021)

STUDY SUBJECTS:Adult patients with Humerus shaft fractures STUDY DESIGN : Prospective analytical study.

SAMPLE SIZE : 30 Cases

30 patients who fulfill the inclusion and exclusion criteria will be considered for the study and will be randomized into 2 groups-

Group 1 –approximately 15 patients will be treated by plate osteosynthesis

Group 2 –approximately 15 patients will be treated by interlocking intramedullary nails

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STATISTICAL ANALYSIS:

Statistical Methods: Descriptive and inferential statistical analysis has been carried out in the present study. Results on continuous measurements are presented on Mean ± SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5 % level of significance. The following assumptions on datas made,

Assumptions: 1.Dependent variables should be normally distributed, 2.Samples drawn from the population should be random, Cases of the samples should be independent.

Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups, Non-parametric setting for Qualitative data analysis. Fisher Exact test used when cell samples are very small.

Significant figures

+ Suggestive significance (P value: 0.05<P<0.10)

* Moderately significant (P value:0.01<P £ 0.05)

** Strongly significant (P value : P£0.01)

Statistical software: The Statistical software namely SPSS 22.0, and R environment ver.3.2.2 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc**.**

INCLUSION CRITERIA

- Closed diaphyseal fractures of humerus shaft
- Type I and Type II open fractures.
- Closed comminuted fractures.
- Segmental fractures
- Fractures 2cm below surgical neck and 3 cm above olecranon fossa
- Patients aged above 16 years

EXCLUSION CRITERIA

- Grade III open fractures
- Pathological fractures
- Age less than 16 years
- Fractures involving Proximal 2 cms and Distal 3 cms of the humeral diaphysis

The functional outcome was measured by the "Disabilities of Arm, Shoulder and Hand" (DASH) Questionnaire at nine months or at full recovery which ever was earlier. The Dash scoring system is a very useful tool to measure function of the upper limb developed by the American Academy of Orthopaedic Surgeons (AAOS) and has been validated by various, studies

RESULTS

There was a total of 20(66.7%) with one or the other post op complications of which 12 patients (80%) belonged to the plating category and 8 patients (53.33%) belonged to nailing category. The results being statistically insignificant (p>0.05). 2 (13.33%) patients had shoulder impingement among the nailing group. 1 (6.67%) patient had implant failure among the plating group. 1 (6.67%) patient among the plating group had post op radial nerve palsy. 2 (13.33%) patients had superficial infection and 1 (6.67%) patient had deep infection among

the plating group. There was no case of infection among the nailing group. 1 (6.67 %) patents had non union among the plating group.

COMPARISON OF FUNCTIONAL OUTCOME

The mean DASH score in plating group is 29.08(SD-12.5843) and nailing group is 29.66 (SD-12.4921) with P value-0.466 which is statistically insignificant. Among the 15 patients in plating group 5 (33.33%) patients had excellent functional outcome, 6 (40%) patients had good functional outcome, 3 (20%) patients had fair functional outcome and 1 (6.67%) patient had poor results Of the 15 patients in nailing group 5(33.33%) patients had excellent results, 9 (50%) patients had good functional outcome and 1(6.67%) patient had fair result. The results are not statistically significant (P).

DISCUSSION

The main advantage of humerus fractures is that it has a good tolerance to anatomical reduction. The indications for a surgical intervention include, shortening more than 3 cm and rotation greater than 30^0, inability to achieve acceptable reduction, vascular lesions, radial nerve palsy, polytrauma, and pathological fractures.

The standard surgical treatment for a humerus fracture is open reduction and internal

fixation. This remains true in the past and the present. The goal of the operative procedure is to achieve and maintain a stable reduction. This will therefore help to mobilise the patient's limb in the shortest possible time and the fracture healing is certain.[3] The downside of open reduction is that it requires extensive tissue dissection and is theoretically associated with high risk of radial nerve injury and more blood loss.

Several studies have shown that intramedullary nailing is the best for fixation of long bones like tibia and femur. In similar fashion intramedullary nailing can be used for fixation of humerus fractures. Though dynamic compression plating has proven to be one of the best methods for stabilizing transverse diaphyseal fractures of humerus[4], the method is not suitable for segmental transverse diaphyseal fractures, communited fractures, gross osteoporosis, non-union and fractures much proximal or distal to shaft.

Interlocking nailing was used to resolve the issues faced by the standard dynamic compression plating though controversy exist over which is the ideal method of fixation.

CONCLUSION

This study is aimed at evaluating and weighing the results of plating and interlocking nailing as a method of treatment for fracture of the shaft of humerus with regards to achieving clinical and radiological union, functional outcome (measured as DASH scoring) and complications.

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We can conclude from our study that both intramedullary and plating are satisfactory in terms of union of the fracture, time to achieve union and functional outcome. However, the number of complications found in the plating group is more concerning, especially those related to the radial nerve injury and rate of infections.

It is also notable that the patients who underwent dynamic compression plating have a better shoulder function than those who has antegrade humeral interlocking. This is attributed to various reasons including uncooperative patients, pain and impingement of rotator cuff by nail and fibrosis. This restriction nonetheless can be released by removal of nail after consolidation followed by the removal of nail after consolidation followed by mobilization and physiotherapy.

In spite of the better reduction attained with Plating, there is a risk of more extensive soft tissue dissection with the risk of radial nerve lesion and infection. In this regard, ILN may be preferred which gives secure and rigid fixation with less soft tissue damage and maintain the anatomy. The removal of the implant is much easier than removal of dynamic compression plate and lesser chances of nerve injury.

advantages of ILN over plating observed in our study are:

1. Lower rate of infection
2. Lower incidence of post op radial nerve palsy
3. Lower incidence of non union due to biological fixation
4. Early mobilization
5. Cosmetically better procedure
6. Preserves the fracture hematoma and requires less surgical dissection

The Disadvantages are :

1. Inadequate compression at the fracture site.
2. Distraction at the fracture site due to improper nail length
3. Impingement due to protrusion of nail at the site of entry.
4. Exposure to Radiation

The advantages of DCP over nailing observed in our study are:

1. Reduced risk of shoulder impingement
2. Better anatomical reduction
3. Time required for union is lesser
4. No need for secondary procedure The Disadvantages are :
5. Needs more soft tissue Dissection.
6. Careful isolation of Radial nerve has to be done.

The Disadvantages are :

Needs more soft tissue Dissection.
Careful isolation of Radial nerve has to be done.
Rate of infection

Therefore, it can be concluded that neither plating nor nailing is superior in all aspects for a particular fracture and the circumstances of each injury should be individually evaluated. Hence it can be said that nailing is ideal for the patients with segmental fractures,

communited fractures, pathological fractures, and patients with gross osteoporosis, patients in which Plating cannot be done, distal end fractures and implant failures. There is also reduced risk of radial nerve injury and the patient can be mobilized earlier. Also, the removal of implant is much easier than the removal of Plate. On the other hand, Plating can be considered when there is a narrow medullary canal, transverse fractures requiring stable fixation and where radial nerve exploration is contemplated.

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fig 1 pre op

fig 2 post op nailing

Fig 3 functional outcome

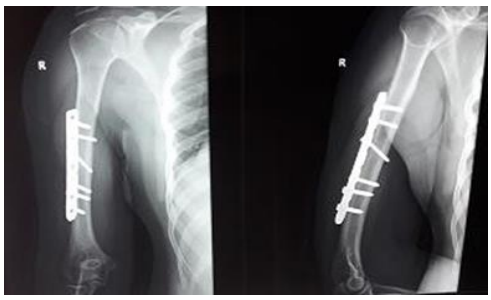

Fig 4 preop fig 5 post op plating

Fig 6 functional outcome

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Table 1 post op complication

Complications	Plating	Nailing	Total
shoulder impingement	0(0%)	2(13.33%)	2 (6.66%)
implant failure	1 (6.67%)	0(0%)	1 (3.33%)
non union	1 (6.67%)	0(0%)	1 (3.33%)
shoulder pain	0(0%)	1 (6.67%)	1 (3.33%)
shoulder stiffness	1 (6.67%)	1 (6.67%)	2 (6.66%)
elbow stiffness	1 (6.67%)	1 (6.67%)	2 (6.66%)
superficial infection	2(13.33%)	0(0%)	2 (6.66%)
Deep infection	1 (6.67%)	0(0%)	1 (3.33%)
Radial nerve palsy	1 (6.67%)	0(0%)	1 (3.33%)
Delayed Union	4(26.6%)	3(20%)	7(23.3%)
Total	12(80%)	8(53.33%)	20(66.7%)

Table 2 functional outcome

Result	Plating	Nailing	Total
excellent	5 (33.33%)	5(33.33%)	10 (40%)
good	6 (40%)	9 (60%)	15 (50%)
fair	3 (20%)	1 (6.67%)	4 (13.33%)
poor	1 (6.67%)	-	1 (6.67%)
Total	15(100%)	15(100%)	30(100%)