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Original article

Humeral shaft fracture management, a prospective study; nailing or plating

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ABSTRACT

Introduction: In this fast moving & advancing era no body want to remain handicapped in immobilization by cast with limited movement. As our knowledge is growing, orthopedic implants and appliances also advancing, and creating a very potential options to manage fracture shaft of humerus by internal fixation either by plate osteosynthesis or interlocking nailing. We are here to evaluate the options of internal fixation; nailing and plating.

Material and method: We prospectively evaluated the results of 30 patients having humeral Shaft fracture. Who were internally fixed by antegrade interlocking nailing (15) and DCP plate (15). Patients are followed up on average of 16–19 months and results were evaluated with standard protocol.

Results: All fractures united uneventfully with usual complication. However we need 2 reoperation in nailing and 1 case of plating for bone grafting.

Conclusion: Internal fixation have immense use in providing better results in form of less deformity, early mobilization and good union. Plating is better option for fixation in terms of less union time, better joint function and lesser reoperation However Nailing is good alternative as minimal invasive approach, less infection, less nerve injury, less chance of implant failure.

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1. Introduction

Fracture shaft of humerus include group of fracture where main fracture line lies distal to surgical neck of humerus and proximal to supracondylar ridge distally. It account for nearly 3.5% of all different type of fractures of bone. 5% of injuries were associated with open wound and 63% were of simple fracture pattern.

Uncomplicated fractures of humerus are treated conservatively by reduction and subsequent immobilization of the arm, successful union occurs in over 90%. Hanging cast, functional bracing, Velpau dressing and shoulder spica are the various available option of conservative treatment. 'Chanley' The pioneer surgeon of orthopedics favors conservative method. However with recent advancement in fracture fixation technique and biomaterial, success of improved surgical

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treatment and low rates complication rate and better efficacy of managing complication, Now a day surgical management of humeral fracture is potential option which is under acceptance as first choice of Management, although non operative treatment is recognized as an effective treatment method for humeral shaft Fracture since long time.

In recent times Poly trauma due to road traffic accidents, Markedly obese patients, elderly with osteoporosis, Segmental fracture, Fracture with more than 50% of comminution all require operative intervention. Lastly Failure of conservative treatment and non Compliance of patient to bulky U cast and increased chance of shoulder and elbow restriction has prompted for operative internal fixations.

2. Material and method

This study was conducted on patients at the Department of orthopedics Surgery and Trauma of Govt. medical college, Haldwani (nainital), Darbhanga Medical College and Hospital, Laheriasari from May 2007 to Jan 2012.

Thirty patients were operated consequently, fifteen with plating and fifteen with nailing. During compression plating we used posterior approach in lateral position and anterolateral approach in supine position. The choice of approach is depend on position and morphology of fracture. A 4.5 mm compression plate DCP was used in all patient inter fragmentary compression by lag screw was used when required. Generally a plate that permitted screw fixation to at least six cortices both in proximal and distal fragment was used.

Antegrade locking nail was used in study there are report to suggest interlocked nailing for fracture in any part of humerus but we have used this technique for the fracture of middle 60% of shaft. Antegrade Nailing was done through minimal invasive approach of shoulder with nail entry site medial to greater tuberosity and just lateral to articular margin. After placing Nail of appropriate size, nail was locked proximally and distally under C arm guidance. Post operatively all patient were initiated on active shoulder and elbow mobilization exercise periodic radiographic evaluation was carried out to look for union to assess the need for additional procedure, Position of the Implant, Evidence of any metal reaction/infection and to check for complication. Functional evaluation was done on the basis of Local tenderness, Persistent wrist drop, Elbow function (Myo elbow performance score), Shoulder function (constant and Murley score) and overall function by American shoulder and elbow surgeon (ASES) Score. Reoperation was done in some case for bone grafting. All patients was evaluated on basis of possible outcome when any two criteria fell into separate category, lower category was selected to classify the outcome.

This is prospective study includes patients with closed fractures of humerus, who were operated with either interlocking nailing or plating within 1 week of injury, with average 16–19 month of post operative follow up. Patient having fractures of proximal humerus, distal humerus, Compound fractures (gastillo type3), and pathological fractures were not included in study.

2.1. Statical analysis

Result were analyzed statically using SPSS 11.5 software with student key test and non parametric test. The value of alpha was set at 0.05.

3. Results

In this study the age range of patients were 17–69 years with mean age being 45.33 years. Maximum patients were from age range 25–35 years (26.66%) followed by 65–75 years (23.33%). Out of 30 patients 18 were male (60%) whereas 12 (40%) were female. maximum cases had minor slip or stumble 30.00%, second most common mode of injury was RTA (26.66%) and major trauma (26.66%). In present study 26.66% cases were single butterfly fragment humeral fracture, which were maximum in this series whereas 23.33% accounts for transverse. Oblique and spiral fractures measured 20% each. Least common comminuted types accounted for only 10%. According to OTA classification maximum cases belongs to A type (Figs. 1 and 3). 36.66% cases were of right sided and 63.33% cases were of left sided. Humeral fracture are operated out of that 15 cases were fixed with plate and 15 cases were fixed with nail. Out of 15 plate group, dynamic compression plate of 6 hole used in 20% cases, DCP of 7 hole used in 40% cases, DCP of 8 hole used in 39.96% cases, lag screw were also used in six cases (Fig. 2). Out of 15 nailing group 26.66% cases were fixed with 7 mm × 26 cm size nail. 33.33% cases fixed with 6.7 mm × 26 cm. 13.33% cases fixed each by 7 mm × 24 cm, 6.7 mm × 28 cm, 6.7 mm × 24 cm nails (Fig. 4). In majority of cases 11 (73.33%) cases treated with closed method without opening fracture site, whereas 26.66% cases need to be open. In this series of study two cases undergone non-union one from plating group and other from nailing group. There were also 2 cases of nailing and 1 case of plating undergone delayed union.

Functional activity at elbow and should joint were assessed in this series by American Shoulder and Elbow Surgeon score, Constant and Murley Score for shoulder function activity, whereas elbow function specially assessed by Myo Elbow performance score. According to shoulder score 66.66% of plating group and 60 of interlocking group showed excellent

Fig. 1 – Pre operative X-ray picture of humeral shaft fracture.

Fig. 2 – Post operative X-ray of humerus with plating of 6 hole DCP.

result (Fig. 5). Good result shown by 26.66% of plating and 33.33% of nailing group. ASES give overall recovery of functional activity of upper limb, both group showed good recovery. Elbow score showed excellent in 60% of plating and 73.33% of nailing. Good in 33.33% of plating and 20% of nailing. Early partial physiotherapy and early mobilization of limb gives good functional recovery. In this series of study two cases undergone non-union one from plating group and other from nailing group. There were also 2 cases of nailing and 1 case of plating undergone delayed union. In present series two patients, who were treated with plating developed nerve injury that was recovered within 6 months duration. No patient of nailing group developed nerve injury (Tables 1–3).

Superficial infection in one case of plating whereas deep infection in one case of plating and one case of nailing were noticed during follows up. Plating is more invasive surgery, so that there are more chances of infection. All these infection subsided with appropriate antibiotic.

Fig. 3 – Pre operative X-ray picture of humerus.

Fig. 4 – Post operative X-ray of humerus with interlocked nail.

Fracture distraction is one of the most important causes of delayed and non-union of fracture shaft of humerus. It is specially seen in nailing group. In our present study 20% cases showed fracture distraction in nailing group whereas none in plating group. Single case undergone implant failure during follow up study. It might be due to osteoporosis. It was treated by arm brace leading to union of fracture ultimately.

4. Discussion

During later part of last century and early part of this decade fracture fixation had undergone revolutionary changes in the form of concept, Technique and Implants. As our understanding of fracture healing increased today, we fix many difficult fractures resulting into better outcome than before, thanks to newer implants with newer technique of fixation.

Bell et al. reported a primary union rate of 97% of cases of humeral shaft fractures in poly trauma patient after plating with average duration of union at 19 weeks. The main complications were loss of fixation in 3%, infection in 3%, and

Fig. 5 – Patient operated with interlocked nailing in right Humerus with 9 month follow up. He achieved almost all normal function at shoulder and elbow.

Table 1 – Patients characteristic who were participated in study.

		Plating	Nailing	Total
Sex	Male	10	8	18
	Female	5	7	12
Side	Right	8	3	11
	Left	7	12	19
Age mean		44.66	46.12	45.33
AO subtype				
A1		4	0	4
A2		9	1	10
A3		1	9	10
B2		1	5	6
Avg. Union- time (App.)		6.9 months	8.7 months	7.8 months

iatrogenic radial nerve palsy in 3% of cases. Functional results were reported as excellent in 97% of patients with a full functioning shoulder in all cases. Similar results were reported by Vander Griend et al. they reported 96% of primary union in series of humeral shaft fracture fixed by DCP. Ingram and his coworkers reported a primary bone union rate of humeral shaft of 95% after interlocking nailing and 90% of the fractures unite within 2 weeks. The results of antegrade intramedullary nailing as regard of union and shoulder joint function are very controversial. Results in published retrospective follow up studies are usually vary widely. Results of comparative studies however have not shown a significant difference in outcome after intramedullary nailing compared with other methods (Wallny et al. 1997b, Lin 1998, Chapman et al. 2000, McCormack et al. 2000). In the present study nailing group showed non-union in 1 (6.6%) cases whereas delayed union in 2 (13.33%) of cases, should impingement in 2 (13.33%) of cases and distraction in 3 (20%) cases. Intra-operative fracture comminution occurred in 1 (6.6%) case. Distraction of fragments was associated with non-union. The medullary canal begins narrowing about 3 cm above the olecranon fossa and this may cause Jamming of nail tip and contribute to distraction at site of the fracture during nailing (Reimer et al, 1994; Rupp et al, 1996). To avoid distraction of the fragments a meticulous operative technique must be properly followed.

Table 2 – Complication in present nailing and plating group study.

Complication	Nailing	Plating
1. Infection :		
Superficial	0	1
Deep	1	1
2. Intra-operative comminution	1	1
3. Fracture distraction	3	0
4. Shoulder impingement	2	0
5. Frozen shoulder	1	1
6. Non-union	1	1
7. Delayed union	2	1
8. Broken implant	0	1
9. Pain around insertion site	2	0
10. Score – ASES Score	42	45
11. Nerve injury (Transient)	0	2
12. Persistent nerve injury	0	0
13. Reoperation	2	1

Table 3 – Functional status in terms of shoulder and elbow score.

Shoulder score (constant and Murley score)		
Shoulder score	Plating	Interlocking nailing
Excellent	10 (66.66%)	9 (60%)
Good	4 (26.66%)	5 (33.33%)
Fair	1 (6.66%)	1 (6.66%)
Poor	0	0
Elbow score :(Myo elbow performance score)		
Elbow score	Plating	Interlocking nailing
Excellent	9 (60%)	11 (73.33%)
Good	5 (33.33%)	3 (20.00%)
Fair	1 (6.66%)	1 (6.66%)
Poor	0	0

The sources of shoulder function impairment after antegrade humeral intramedullary nailing are unclear. Proximal migration of nail may cause subacromial impingement in average of 16% of patients. But it is not a major problem with interlocking nailing. According to clinical experience, shoulder pain after antegrade interlocking nail is not that of typical subacromial impingement syndrome. According to Ikepeme (1994) proximal locking screws protruding into deltoid muscle may be major source of shoulder pain. Old aged has been recognized risk of shoulder stiffness even in conservative treatment (Koch et al, 2002). In plating group 1 (6.6%) case showed non-union and delayed union in 1 (6.6%) case but there were more chances of infection 2 (13.33%) in our series of plating as compared to nail group in which only 6.66% case showed infection. More infection in plating is explained by slightly longer duration of operative time due to old neglected cases which were difficult to reduce. In our series plates were mainly applied as neutralization plate Problems of broken implant shown in 1 (6.66%) case during follow up. Functional activity recovery is little better in plating group as compared to nailing group. Nerve injury in our case series is about 2 (13.33%) in plate group as compared to nil in nailing group. However, all cases recovered within six months of follow up with conservative way of management. None need operative management. The incidence is higher than that reported by other investigator. This would be explained by mishandling of tissue and nerve by assistant contributed by non recognition of radial nerve all the time. However no radial nerve injury seen in our nail group. Ingram and Wales who reported zero percent incidence of iatrogenic radial nerve palsy after nailing. Our study supports this result. In our series plates were mainly applied as neutralization plate. The union was fair and acceptable. We assessed attainment of normal functions by different scores like, for shoulder constant Murley score, for elbow Myo performance score and overall by American shoulder and elbow surgeon score. In our case series we got fair normalcy towards patient's own works and routines and it is comparable to other literatures.

Average hospital stay after initiation of definite treatment was 15 days in plating method group and 14 days in interlocking nailing method group. Sometimes infection of wound may need 1 or 2 dressing making hospital stay longer.

Out of 15 case in plate group, dynamic compression plate of 6 hole used in 20% cases, DCP of 7 hole used in 40% cases, DCP of 8 hole used in 39.66% cases lag screw were also used in two cases. The role of locking or hybrid locking plating techniques for humeral shaft fractures remains a topic of debate. In the setting of normal-quality bone and simple fracture patterns, standard compression plating remains an effective technique for humeral shaft fracture fixation from both a biomechanical and cost perspective. In a recent study comparing locking plates with non-locking plates for a comminuted midshaft fracture model, no biomechanical advantage was noted with regard to torsion, bending, or axial stiffness between the 2 constructs.

Western population needs thicker implant as their medullary canal are more wider and bone are more stronger. In this series of study two cases undergone non-union one from plating group and other from nailing group. There were also 2 cases of nailing and 1 case of plating undergone delayed union. Shaft of humerus generally undergo non-union due to soft tissue interposition, osteoporosis and comminution and also distraction. These are important predictor of non-union. Patients are advised to do active or passive physiotherapy gradually after stitch removal. Functional activity at elbow and shoulder joint were assessed in this series by American Shoulder and Elbow Surgeon score, Constant and Murley Score for shoulder function activity, whereas elbow function specially assessed by Myo Elbow performance score. According to shoulder score 66.66% of plating group and 60 of interlocking group showed excellent result. Good result shown by 26.66% of plating and 33.33% of nailing group. ASES give overall recovery of functional activity of upper limb, both group showed good recovery. Elbow score showed excellent in 60% of plating and 73.33% of nailing. Good in 33.33% of plating and 20% of nailing. Early partial physiotherapy and early mobilization of limb gives good functional recovery.

In present series two patients, who were treated with plating developed nerve injury that was recovered within 6 months duration. No patient of nailing group developed nerve injury. In plating open reduction and internal fixation required so nerve may be mishandled during surgery or may be compressed in plate. Nerve caught in plate lead to permanent damage. Here no case had undergone permanent damage. Nailing does not need to be opened in many cases, so, there were also less chance of mishandling so it may be cause of less nerve injury compared to plating group.

Superficial infection in one case of plating whereas deep infection in one case of plating and one case of nailing were noticed during follow up. Plating is more invasive surgery, so that there are more chances of infection. All these infection subsided with appropriate antibiotic. Single case undergone implant failure during follow up study. It might be due to osteoporosis. It was treated by arm brace leading to union of fracture ultimately.

5. Conclusion

Internal fixation with various fixation devices allows early mobilization and good functional recovery. Operative treatment results with dynamic compression plate and interlocking nail were comparable in many senses with some pits

and fall in each group like union time, distraction, nerve injury, shoulder impingement, infection and implant failure. Implant choice depends upon indications, discussion with patient and choice of surgeon, which implant they want to use for internal fixation of these fractures. But in my view, in well evaluated patients, where indications are clear choice for internal fixation with either implant is optimal management. Both plating and nailing has own its benefits and demerits. Which implant is more preferable, is not very conclusive and it need more study and meta analysis.

Conflicts of interest

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

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