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A COMPARATIVE STUDY OF PLATE OSTEOSYNTHESIS VERSUS LOCKED INTRAMEDULLARY NAILING IN DIAPHYSEAL HUMERUS FRACTURE IN ADULTS

Orthopedics

Dr Ravindra Prasad* Senior Resident, Department of Orthopedics, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand. *Corresponding Author

Dr L B Manjhi Professor, Department of Orthopedics, Rajendra Institute of Medical Sciences, Ranchi, Jharkhand.

ABSTRACT

Introduction: Nonoperative treatment of fracture of humeral diaphysis generally has provided acceptable results. However, to achieve faster union and early return to preinjury state along with preserving functionality and motion of adjacent joints, operative management is preferable. Various choices of internal fixation for managing these fractures exist. However, the preferred method of internal fixation for these fractures remains debatable. **Aim:** to compare the clinical, radiological, functional outcome of plate Osteosynthesis versus intramedullary nailing in management of diaphyseal humerus fracture in adults. **Method:** a prospective, randomized study including 49 patients with diaphyseal fracture of humerus randomized into two groups in which one group (n=29) was treated with internal fixation with plate Osteosynthesis while the other group (n=20) was treated with antegrade intramedullary nailing. Parameters examined included shoulder and elbow range of motion and evidence of clinical and radiological union along with presence of any complication. **Result:** Mean age of the patients in the Plating group was 44.3 years while in the Nailing group, it was 42.9 years. Mean time to radiological union in the plating was 17.6 weeks compared to 15.7 weeks in the nailing group. Non union was seen in 6.8% of patients with plating as compared to 10% in patients treated with nail. Mean ASES score for plating group was 81.6 while for the nailing group it was 76.3.

Conclusion: For diaphyseal fracture of humerus in adults, both the treatment modalities i.e. antegrade intramedullary nailing and internal fixation with plating are almost similar with regard to functional outcome and union rate. Antegrade Intramedullary nailing has better rate of union but is associated with significantly increased risk of shoulder complications which may adversely affect outcome. Plating isour treatment modality of choice for managing these fractures in view of minimal complications with optimal outcome.

KEYWORDS

diaphyseal fracture humerus, intramedullary nailing, plating

INTRODUCTION

Fracture of humeral diaphysis are commonly encountered by orthopedic trauma surgeons with general incidence amounting to 1-2% of all fractures and 13-14% of all humerus fractures. Nonoperative treatment of these fractures generally has provided acceptable results since ages as residual malalignment is compensated well by shoulder and elbow joints though inherent complications of long term immobilization with nonoperative treatment can't be ignored. Operative treatment of these fractures has traditionally been reserved for fractures with unacceptable alignment and inadequate reduction, open fractures, segmental fractures, fractures associated with neurovascular injury, multiple injury, floating shoulder and elbow and in cases of nonunion. Hence, to achieve faster union and early return to preinjury state along with preserving functionality and motion pf adjacent joints, operative management is preferable. Past two decades has seen significant advancement in operative management of these fractures with a variety of choices for internal fixation like dynamic compression plating (DCP), locking compression plating (LCP), LC-DCP, external fixation, intramedullary nailing and TENS nailing. However, the preferred method of internal fixation for these fractures remains debatable as different studies done in this regard haven't been uniform in their conclusion. Plate Osteosynthesis with DCP or LCDCP are claimed to achieve anatomical reduction with good compression across fracture site but at the cost of periosteal stripping, longer incision with excessive tissue dissection, increased risk of infection and neurological injury with less secure fixation in osteopenic bones of elderly population.

Intramedullary humeral nails have undergone appreciable and continuous innovation in their design with time and have the advantage of biomechanical load sharing, lesser soft tissue disruption with preservation of extramedullary blood supply and maintenance ofrotational and torsional stability but standard antegrade entry portal is feared with complications of rotator cuff impingement, shoulder pain and restricted movement of adjacent joints. Hence, present study is aimed at comparing the clinical, radiological and functional outcome of plate Osteosynthesis versus intramedullary nailing in management of diaphyseal humerus fracture in adults as well as their complications.

MATERIAL AND METHODS

This is a prospective, comparative, randomized study carried at Rajendra Institute of Medical Sciences, Ranchi between November 2019 to May 2021 after Ethical committee approval. We included a total of 49 patients with diaphyseal fracture of humerus meeting the inclusion and exclusion criteria. Randomization of the patients was done in two groups in which one group was treated with internal fixation with plate Osteosynthesis using DCP or LCDCP while the other group was treated with antegrade intramedullary nailing using Humerus interlocking nail. A written informed consent was taken from all patients undergoing the study.

Inclusion Criteria:

1) Age more than 18 years
2) Fracture in diaphyseal region of humerus (between 3cm distal to surgical neck and 5cm proximal to olecranon fossa)
3) Closed fracture and open fracture (Gustilo Anderson grade 1)

Exclusion Criteria

1) Concomitant shoulder or elbow pathology
2) Open fracture (Gustilo Anderson grade 2 and 3)
3) Pathological fracture
4) Associated neurovascular injury
5) Polytrauma patients
6) Patients unfit for surgery and refusal for informed consent

Upon arrival of the patients in Emergency room or OPD, detailed history was taken to reveal the mechanism and severity of trauma and a careful clinical examination performed with particular attention to status of radial nerve and to rule out any associated injury.

Anteroposterior and lateral radiographs of injured arm including shoulder and elbow were obtained and provisional stabilization of fracture was done with U slab. Any associated medical comorbidity was optimized prior to surgery. Most of the patients underwent fixation within 10 days of admission.

Surgical Technique:

For Plate Osteosynthesis, an anterolateral approach was used for fractures located in the proximal and middle third of the humeral shaft whereas distal third fractures were approached using posterior incision. Fracture reduction was done using manual traction and with the help of reduction clamps. A narrow 4.5mm DCP or LCDCP was used for fracture fixation after achieving anatomical reduction. A minimum of eight points of cortical contact was obtained on either side of fracture. In cases where interfragmentory screw was used, a

minimum six cortices hold on each fracture fragment was assured.

For intramedullary nailing using Humerus interlocking nail, antegrade entry portal was used using a skin incision from the anterolateral corner of acromion splitting the deltoid in the raphe between anterior and middle third. Portal was made just lateral to humeral head articular surface and medial to greater tuberosity. Fracture reduction was done using fluoroscopic guidance. Sequential reaming was done over guide wire and humeral nail was used to fix the fracture with two transfixion bolts both proximally and distally. Due care was taken to prevent damage to rotator cuff during nail insertion. Postoperatively an earlyrehabilitation program was started with active assisted range of motion exercises from the very next day.

All the patients were followed up regularly at 2 weeks, 6 weeks and monthly thereafter and assessed clinically and radiographically at each visit. Parameters examined included pain and tenderness over fracture site, shoulder and elbow range of motion and evidence of clinical and radiological union along with presence of any complication. Final functional assessment was performed at the end of 6 months using American Shoulder and Elbow Surgeons Score (ASES). Statistical analysis was performed through IBM SPSS software using Student's t test, chi square test and Fischer's exact test. A p-value of <0.05 was considered statistically significant.

RESULT AND DISCUSSION

A total of 49 patients were included for this study of which 29 patients were managed with Osteosynthesis using Plating while remaining 20 patients were treated with Intramedullary humeral nailing.

Mean age of the patients in the Plating group was 44.3 years (range 24-67 years) while in the Nailing group, it was 42.9 years (range 21-61 years). Gender analysis revealed predominance of female population in both the groups with 61.1% females in Plating group and 53.8% females in Nailing group. Most of the injuries were as a result of RTA (55.1%) while in 34.7% cases, mode of injury was simple fall over ground. All the fractures were classified s per AO/OTA classification and anatomical location of humeral diaphysis. Most of the fractures were of type A (77.5%) whereas type C fractures were least common (8.2%). Majority of the fractures (71.4%) were located in middle third of diaphysis. No significant differences were seen with regard to demographic variables and the type and location of fracture among the two groups.

Table 1: Relevant Patient Related, Intraoperative, Functional Result And Complication Related Variables Between The Two Groups

Parameter	Plating	Nailing
Sample size (n)	29	20
Mean age (year)	44.3	42.9
Gender (M/F)	11/18	7/13
Duration of surgery (minute)	94	81
Wound infection	2 (6.8%)	1 (5%)
Iatrogenic nerve palsy	1 (3.4%)	none
Shoulder pain	none	4 (20%)
Elbow pain	1 (3.4%)	none
Restricted ROM shoulder	1 (3.4%)	3 (15%)
Restricted ROM elbow	3 (10.3%)	2 (10%)
Mean time of union (week)	17.6	15.7
Non union	2 (6.8%)	3 (15%)w
Mean ASES	81.6	76.3

Mean operative time for plating was 94 minutes while for the nailing group, it was shorter i.e. 81 minutes. However, this difference was found to be statistically not significant.

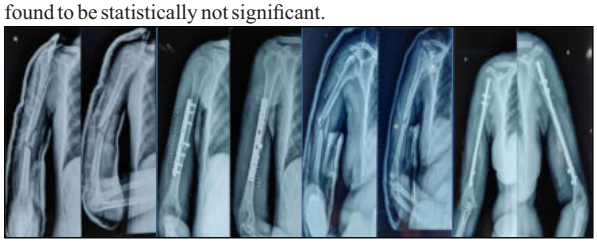

Figure 1: Pre and postoperative radiograph of humerus plating

Figure 2: Pre and postoperative radiograph of humerus interlocking nailing

This study also compared the rate of complications among the two groups. In the plating group, two cases of infection (6.8%) were seen both superficial in which one of them required prolonged wound care in form of regular dressing with occasional debridement with prolonged antibiotic coverage. Both the cases eventually had satisfactory outcome. One of the patients in nailing group (5%) developed superficial infection over shoulder entry portal which also healed with regular dressing and antibiotics. Rate of infection among the two groups was statistically insignificant.

Incidence of postoperative radial nerve palsy in various studies has been reported to be 2% to 5% as a complication of plate osteosynthesis. With interlocking, rate of palsy ranges from 2.6% to 14.3% as per different studies. Iatrogenic radial nerve palsy manifesting as wrist drop was seen in only one patient in the whole study population in the plating group. In this patient, fracture was located at the junction of middle and lower third and a triceps splitting approach was used for internal fixation. However, it was only neuropraxia and complete recovery was observed without any residual weakness within 2 months. No nerve injury was reported in any of the patients in the nailing group.

Persistent shoulder pain after antegrade intramedullary nailing is uniformly reported in various studies. Cause of pain can be multifactorial like damage to the rotator cuff during reaming and nail insertion, proximal migration of nail, adhesive capsulitis or may be unexplained. Ouyang et al found that the risk of shoulder impingement and restricted shoulder movement can be reduced by plate fixation. In our study, we have 4 cases with postoperative persistent shoulder pain with antegrade nailing amounting to 25% while none in the plating group. This difference was found significant. This also had an adverse consequence over functional outcome as resultant restricted shouldermotion can sometimes lead to stiffness. This complication can be minimized by meticulous exposure of rotator cuff and its adequate repair at the end of procedure. Burying the nail subchondral should also be ensured to prevent proximal nail migration thereby avoiding shoulder impingement.

Mean time to radiological union in the plating group was 17.6 weeks while in the nailing group, it was 15.7 weeks. Study conducted by Saroj et al shown healing time of 16.06 weeks for plating as compared to 14.05 in the nailing. Though union rate was relatively rapid in interlocking group, difference was not found to be statistically significant.

Non union was seen in 6.8% of patients with plating as compared to 10% in patients who were treated with nail. This demonstrates a higher rate of union in patients treated with plating though statistically it was not significant. Incidence of nonunion with plating in other studies were reported to be 2-4%. Study by McCormack et al has a non-union rate of 4.4% while Kingisetti et al found a non-union rate of 6.25%. Changulani et al reported a non-union rate of 12% with plating. Incidence of non- union with intramedullary nailing as reported by McCormack et al was 9.5%, by Singisetti et al 5% and by Changulani et al it was 14.3%.

Functional outcome in present study was assessed using American Shoulder and Elbow Surgeons (ASES) score where the pain visual analog scale (VAS) and 10 functional questions are used to tabulate the score. A total score of 100 is weighted 50% for pain and 50% for function.

Mean ASES score for plating group was 81.6 while for the nailing group it was 76.3 estimated at the end of 6 months. Hence, this study demonstrated a better functional score with plating as compared to nailing. Marginally poor functional score in nailing group may be attributed to shoulder function complications in these patients. Intramedullary interlocking humeral nails used in diaphyseal humerus fractures have the advantage of load sharing with improved biomechanics.

In the study of Chen et al to study the fixation stability of plate with locked antegrade humeral nail found that there was no difference in cyclic loading between the two groups for average gap displacement or construct stiffness. They stated that although fixation stability with both methods is similar under physiologic loads, nail demonstrates higher load to failure which may have implications for multiple fracture patients in whom partial weight bearing on upper extremity may be necessary.

Open reduction and Internal fixation with Plating has the advantage of achieving anatomical reduction of fractured fragments without any violation of rotator cuff tissues avoiding impingement of shoulder with improved functional outcome. However, extensive tissue dissection and fear of failure in osteoporotic bones of elderly remain its chief disadvantages. In comparison, nailing is less invasive procedure with advantages of minimal soft tissue handling, preservation of fracture hematoma and avoidance of periosteal stripping. Moreover, generation of reamed marrow contents over the fracture site accelerates healing of fracture. However, violation of rotator cuff tissues and nail tip impingement over shoulder with resulting restriction of movement of shoulder and stiffness are its primary disadvantages.

Ouyang et al in their metaanalysis to compare the results of intramedullary nailing and plating technique concluded that there is no significant difference in both these methods except for increased shoulder complications in nailing group. Report by Elango et al stated that none of these implants are superior to other in terms of fracture union and functional outcome and choice of implant for treating these fractures solely relies upon surgeon's discretion. Mamood et al also had similar conclusion. They concluded that no single treatment methodcan be a preferred choice for humeral shaft fractures and each case has to be individualized for a particular fracture. Study by Mir et al stated nailing to be an effective surgical option though at the risk of higher shoulder related complications. Chao et al reported significantly decreases blood loss in nailing as compared to plating. Finkfilla et al analyzed shoulder scores from different studies and found the scores to be similar in both in both nailing and plating groups with plating having better shoulder abduction and flexion.

Main limitation of our study remains relatively small sample size with a shorter duration of follow up. We feel that a larger study sample with longer duration of follow up is required for firmer validation of results.

CONCLUSION

Based on the results of the present study, we can conclude that for diaphyseal fracture of humerus in adults, both the treatment modalities i.e. antegrade intramedullary nailing and internal fixation with plating are almost similar with regard to functional outcome and union rate. Plating has got the advantages of anatomical reduction of fracture with rigid and stable fixation. However, excessive soft tissue dissection with increased blood loss is inevitable. Antegrade Intramedullary nailing is less invasive, has better rate of union but is associated with significantly increased risk of shoulder complications in form of impingement and stiffness which may adversely affect outcome in some patients. Therefore, Plating is our treatment modality of choice for managing these fractures in view of minimal complications with optimal outcome except in some selected cases like osteoporotic and pathological fractures, long segmental fractures and multiple injury patients where intramedullary nailing can be preferred.

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