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COMPARISON OF INTRAMEDULLARY NAIL AND PLATE IN MANAGEMENT OF MID DIAPHYSEAL FRACTURES OF HUMERUS

Orthopaedics

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ABSTRACT

Introduction Comparison of intramedullary nailing with plating in management of Mid diaphyseal fractures of humerus is still matter of debate due to lack of definitive evidence. The aim of our study was to compare the results of nailing and plating with regards to functional outcome, radiological union, surgical time ,hospital stay and complication. **Material and methods** 4o patients were included in our study.20 patients were managed with intramedullary nail and 20 with open reduction and internal fixation with plate. Mean age in plating group A was 44.95 years and 38.1 years in nailing group B. 15 were male and 5 were female in plating group A and 11 were male and 9 were female in nailing group B. Road traffic accident was most common mode of injury. In plating group A 13 belong to AO type 12 A, 5 to AO type 12 B and 2 to AO type 12C .In nailing group B 6 belong to AO type 12 A, 9 to AO type 12 B and 5 to AO type 12C. Functional outcome was assessed using American shoulder and elbow score in both the groups. **Results** The average operating time was 74.65 minutes in plating group A and 58.5 minutes in nailing group B. Mean blood loss was 294.6 ml in plating group A and 159.2 ml in nailing group B Average Hospital stay was 7.3 days in plating group A and 4.7 days in nailing group B. Mean time to union was 14.35 weeks in plating group A and 13.05 weeks in nailing group B. Mean ASES at the end of follow up was 44.85 in plating group A and 45.65 in nailing group B. **Conclusion** In our study no difference was observed in plating and nailing group with respect to union time and and functional outcome. Nailing group had added advantages of less surgical time, shorter hospital stay , less blood loss and shorter union time. We conclude that nail is an effective option compared to plate in the management of mid diaphyseal fractures of humerus.

KEYWORDS

NAIL,PLATE,HUMERUS

INTRODUCTION

Mid diaphyseal fractures of the humerus accounts to 1-2% of all fractures in the human skeleton and 14% of all fractures confined to humerus itself[1]. Incidence is equal both among men and women upto 60 years of age there after increases in women[2]. The most common mechanism of injury is fall followed by road traffic accidents[3]. Other mechanism include fall from height, assault and pathological fractures[4]. Injuries associated with diaphyseal fractures include radial nerve injury (10-12%), ipsilateral shoulder dislocation, soft tissue injuries of rotator cuff, floating elbow, other long bones fractures in polytrauma patient[8].

Generally acute, closed and uncomplicated diaphyseal humerus respond with high union rate and good functional outcome when treated with conservative methods like hanging cast, coaptation splint, velpeau bandage and functional humerus brace [6,7]. However due to improved surgical techniques, morbidities associated with conservative management and demand for faster recovery and return to pre morbid status internal fixation is being favoured. Various modalities of internal fixation includes osteosynthesis with plate and screw construct, interlocking intramedullary nail, Titanium elastic nail system[9]. All modalities have certain biomechanical and physiological advantages and disadvantages with specific indications and contraindications. Plating requires extensive dissection, risk of iatrogenic radial nerve injury, non-union. While intramedullary nails have advantages of closed procedure without disturbance of fracture hematoma, periosteal stripping, load sharing device. But still has some issues regarding rotator cuff injuries, radial nerve injury during manipulation, impingement at entry site. Proponents of plate fixation believed in absolute stability while that of nail fixation in relative fixation as it was successful in other long bones. Numerous studies have guided surgeons in operative management with absolute and relative indications and contraindications.

The goal of our study was to compare intramedullary nail with plate in management of diaphyseal fractures of humerus in adults with respect to functional outcome, hospital stay, blood loss, complication rate and radiological union.

MATERIALAND METHODS

A prospective comparative randomised study between antegrade interlocking nail and osteosynthesis by locking compression plate in the management of mid diaphyseal fractures of humerus was conducted in the department of orthopaedics, government medical college and hospital, nagpur. Approval of hospital ethics committee was sought. We looked at mid diaphyseal fractures treated between 2018 and 2020 amounting to 40 patients. They were randomly divided into two groups, intramedullary nailing and plating equally to 20 patients. Of these 26 were men and 14 were women. The inclusion criteria were closed mid diaphyseal humerus fractures in age group 18 to 65 years sustained fracture within 2 weeks of surgery without radial nerve paralysis and vascular compromise. The exclusion criteria were fractures within 4cm of the proximal and distal end of humerus, compound fractures of grade 2 and grade 3, pathological fractures, patient aged less than 18 years and more than 65 years, patient with severe comorbidities like psychiatric illness, cardiovascular diseases, cognitive disorders. A thorugh history and clinical examination were done of the patient. Other associated injuries were noted. Radial nerve status was documented for medicolegal purposes. Plain radiographs of of the involved limb with adjoining joint were taken. Patient was taken to operating table after written informed consent and pre anaesthesia clearance. Patients were randomly treated with plate and nail for fracture fixation. Patients were aged between 18 to 65 years with left side involved in 23 patients and right side involved in 17 patients. AO classification was used to classify the fracture. Of these 19 were type A,14 were type B,7 were type C.

Patients were preoperatively given injectable ceftriaxion single dose.
In the plating group A, surgery was approached via posterior or anterolateral. Fixation was done with 4.5mm locking compression or dynamic compression plate preferably 8 cortices proximally and distally and lag screws in cases of oblique and spiral fractures. Plate with 8 to 13 holes were used depending on fracture configuration. Radial nerve was carefully and meticulously dissected and protected.
In nailing group B a surgery done in lateral or supine position on a radiolucent table. A 2-3 cm incision was made from anterolateral edge of the acromion obliquely forward and deltoid muscle is split longitudinally along its fibres to reveal the subacromial bursa and the rotator cuff entry was taken with awl medial to sulcus of greater tuberosity. Gentle manipulation was done to reduce the fracture guide wire was passed. Sequential reaming was done.7mm nail was used in 9 patients and 8mm in 11 patients. Nail was fixed proximally with 2 bolts and distally with 1 bolt directed anteroposteriorly. It was made sure that nail has sunken considerably to avoid problems of impingement. The rotator cuff repair was done. All was done under C-arm image intensifier.

The blood loss was calculated from a modification of the gross formula given below:
Blood loss=blood volume [hct(i)-hct(f)]/hct(m) where blood volume

= body weight (kgs) * 70 ml/kg; hct (i), hct (f) and hct (m) were the initial, final and mean (for final and initial) haematocrits, respectively.
Post operative radiographs were done to assess fracture fixation. Neurovascular status was documented immediately post operatively. Patients were given cuff and collar support or arm pouch postoperatively. Passive abduction flexion exercises of shoulder and flexion and extension exercises of elbow were commenced on second post operative day. Active exercises were started after suture removal which was done after 10 to 14 days of surgical procedure. Patients were followed up at2,6,12,24,36 weeks with final follow up at 52 weeks. Radiographic assessment was done for any evidence of callus formation, infection, malunion, non-union. Functional outcome was assessed using American shoulder and elbow scoring system. The American shoulder and elbow surgeons A.S.E.S. shoulder score is for 13 activities of daily living requiring full shoulder and elbow movement. The maximum possible score is 52 points. Fracture healing was considered as callus formation in two orthogonal planes. No evidence of radiological healing by 16-18 weeks was considered as delayed union. No union even after 32 weeks was considered as non-union.

Statistical analysis of the results was done with student's t-test.the p-value was set to 0.05.

RESULTS

In our study 20 patients underwent intramedullary nailing and 20 patients underwent 4.5mm locking compression plate.

In the plating group A 15 were male patients and 5 were female patients with mean age of 44.95 years (s.d.=15.03). In the nailing group B, 11 were male patients and 9 were female patients with mean age of 38.1 years (s.d.=16.02).

In the plating group A 13(65%) patients belong to aotype12 A,5(25%) patients belong to AO type B,2(10%) patients belong to AO type C. In the nailing group B 6(30%) patients belong to AO type12 A,9 (45%) patients belong to AO type12 B,5(25%) patients belong to type 12C.

Road traffic accident was the most common mode of injury having 11 patients in the plating group and 10 patients in nailing group. Domestic fall was second most common having 7 patients in plating group A and 9 patients in nailing group B. Assault was the least common cause in our study having 2 patients in plating group A and 1 patient in nailing group B.

The right upper limb was commonly involved in both the groups with 12 patients in group A and 11 patients in group B. Left upper limb was involved in 8 patients in plating group A and 9 patients in nailing group B.
The most common associated injuries were other long bone fractures, followed by head injury, chest injury, abdopelvic injury.

The average operating time in plating group A was 74.65 (s.d.=5.8).the average operating time in nailing group B was 58.5 (s.d.=5.11) which was statistically significant(p value <0.05).

The average hospital stay was 7.3 days(s.d.=1.45) in plating group A and 4.7(s.d.=1.43) days in nailing group B. The difference being statistically significant in nailing group B.

The average blood loss in plating group a was 294.6ml(s.d.=30.97) in plating group A and 159.2ml(s.d.=11.57) in nailing group B. The difference being statistically significant in nailing group B.

Fracture healing was considered as callus formation in two orthogonal planes. In the plating group a 2 patients had delayed union and united at 17 and 18 weeks respectively. 1 patient had non union which was treated with autologous bone grafting and plate fixation. The average union time was 14.35 weeks (s.d.=2.88) in plating group A. In the nailing group B 1 patient had delayed union uniting at 18 weeks. There was no case of non-union in nailing group B. The mean duration of union was 13.05 weeks (s.d.=1.76) in nailing group B. The difference in union time between both the groups was not statistically significant.

There were 2 cases of radial nerve palsy in plating group A which recovered at 8 and 10 weeks with 1 case of radial nerve injury in nailing group B which recovered at 6 weeks. There was one case of implant failure in plating group A and 1 case of superficial infection in plating group A which resolved with culture sensitive antibiotics. One patient in the nailing group had protruded nail which was removed after union.

The mean American shoulder and elbow score at the end of 52 weeks was 44.85(s.d.=1.46) in the plating group A and 45.65(s.d.=1.22) in nailing group B. There was no statistically significant difference in the functional outcome at the end of year on both the groups. Results are tabulated in table 1 ,2 and 3

DISCUSSION

The indications and contraindications of operative, as well as nonoperative treatment of humerus mid diaphyseal fractures, are constantly changing and subject to review on case to case basis. Better understanding of fracture fixation, implants, surgical techniques and improved socioeconomic status of the people, internal fixation offers a faster recovery and early return to pre morbid status. Indications of internal fixation were first described by bandi which included unacceptable reduction after conservative methods, open fractures transverse fractures, comminuted fractures with radial nerve palsy and pseudoarthrosis [9]. This list has been upgrading on a regular basis since last 10-20 years and newer indications like segmental fractures, bilateral fractures floating elbow, polytrauma, neurovascular deficit following penetrating trauma[15]. Modalities of internal fixation in the treatment of mid diaphyseal fractures include plate osteosynthesis and intramedullary nailing which we are comparing in our study. Though definitive evidence is lacking which is better for the management of mid diaphyseal fractures.

The epidemiology shows that there is equal preponderance of diaphyseal fractures both in men and women up to 60 years of age. Thereafter it slightly increases in women[2].

The most common reason for humerus shaft fractures is road traffic accident followed by domestic fall[3]. Other causes include pathological fractures, violence. Socioeconomic and geographical factors influence the prevalence of humeral shaft fractures and mechanism of injury[4].

Plate osteosynthesis allows absolute fixation, exploration of radial nerve at the cost of extensive dissection, exposed fracture hematoma and presence of cosmetically unsighted scars[11,23]. Though recent techniques of minimally invasive percutaneous plate osteosynthesis has shown some promising results[5].

Proponents of intramedullary nailing have cited various advantages which includes shorter operative timeless blood loss, favourable for pathological, segmental and comminuted fractures, high rates of union and good functional outcome, rotationally stable fixation, less chances of iatrogenic radial nerve palsy, load sharing device[12,16].Minimally invasive and biologic procedure, preservation of blood supply are added benefits. Also Nail fixation can be better option for those patients who are having higher American society of anaesthesiologists grade[20].

Opponents of intramedullary nailing have emphasized problems of fracture site distraction leading to delayed, non-union, impingement at acromion, breach of rotator cuff and adhesive capsulitis, non weight bearing bone, lower shoulder functional score[11,13,16,19,22,23,25].

The issues related to nailing group can be minimized by a entry more medial to sulcus of greater tuberosity through musculotendinous area, meticulous repair of cuff to avoid rotator cuff tendon injury , adequate assessment of nail length, burying of the nail to avoid impingement.

Chapman et al recommended plating as best treatment for humerus shaft fractures as nailing was technically demanding and had higher rate of complications[13].

On the contrary, Changulani et al found higher rate of complications in plating and nailing as a better surgical intervention for humerus diaphyseal fractures[16].

Denies et al suggested that plating of humeral shaft fractures should be considered as the primary treatment for all surgical indications, except for some open fractures requiring temporary external fixation, pathological fractures, humeral shaft fractures in morbidly obese and osteopenic patients, and large segmental fractures of the humerus[14].

Meta-analysis by bhandari et al elucidated that plate fixation of

humeral shaft fractures may reduce the risk of reoperation and shoulder impingement[19].

Guo-dong liu et al in his metanalysis concluded that there was no significant difference between plate fixation group and intramedullary nailing group in terms of nonunion, infection, radial nerve palsy[18].

Failure of significant difference between ases scores of plating and nailing was endorsed by various study and meta-analysis[16,17].

The drawback of our study was small sample size for comparison between plating and nailing group.

CONCLUSION

We concluded that modalities of internal fixation need to be prioritized on specific indications and contraindications and on a individual basis. Even though there were no significant differences between plating and nailing group in terms of union and functional outcome. Nailing had added advantage of shorter hospital stay, operating time and blood loss. Nevertheless disadvantages of rotator cuff disruption, shoulder impingement can be eliminated by proper and meticulous techniques.

Tables 1

	PLATE (GROUP A)	NAIL(GROUP B)
AGE (MEAN)	44.95+/-15.03	38.1+/-16.02
SEX (MALE/FEMALE)	15/5	11/9
SIDE (RIGHT/LEFT)	12/8	13/7
MODE OF INJURY RTA FALL ASSAULT	11 7 2	10 1 9
AO TYPE A	13	6
AO TYPE B	5	9
AO TYPE C	2	5

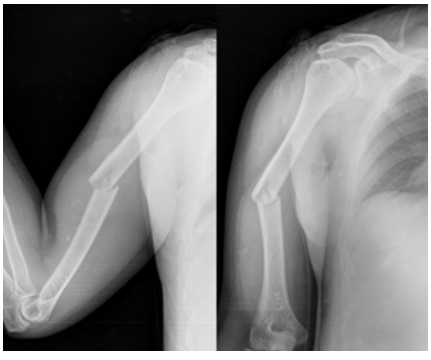
TABLE 2

	PLATE (GROUP A)	NAIL (GROUP B)
OPERATING TIME(AVERAGE)	74.65+/-5.8	58.5+/- 5.1
BLOOD LOSS (AVERAGE)	294.6+/-30.97	159.2+/-11.57
AVERAGE HOSPITAL STAY	7.3+/-1.45	4.7+/-1.43
TIME TO UNION(MEAN)	14.35+/-2.88	13.05+/-1.76
NON UNION	1	0
DELAYED UNION	2	1
RADIAL NERVE PALSY	2	1
IMPLANT FAILURE	1	0
INFECTION	1	0

TABLE 3

	PLATE (GROUP A)	NAIL (GROUP B)
AVERAGE ASES AT 1 YEAR	44.85+/-1.46	45.65+/-1.22

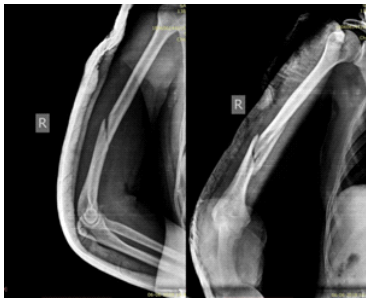
PATIENT 1



PRE-OP X RAY

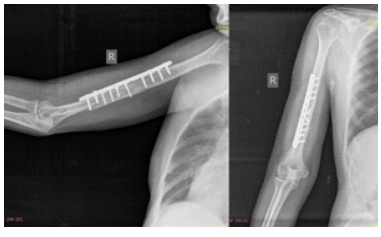
IMMEDIATE POST OP X RAY

UNION AT 12 weeks
PATIENT 2



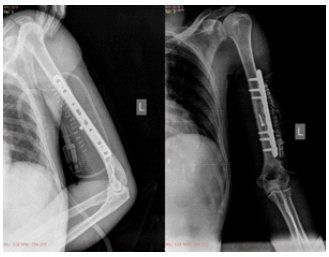
PRE-OP X RAY

IMMEDIATE POST OP X RAY

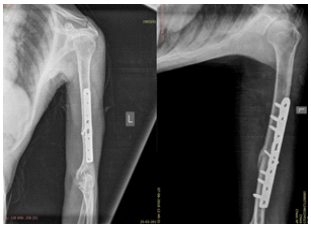


UNION AT 14 weeks
PATIENT 3

PRE-OP X RAY



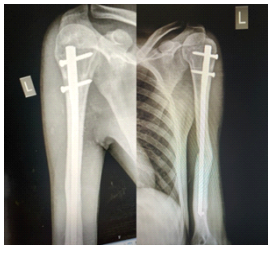
IMMEDIATE POST OP X RAY



UNION AT 15 WEEKS
PATIENT 4

PRE-OP X RAY

IMMEDIATE X RAY



RADIOLOGICAL UNION AT 12 WEEKS.

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