Original Research Article

A comparative study of functional outcome of dynamic compression plating versus interlocking nailing for fracture shaft of humerus at tertiary care center

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Abstract

Background: Humeral shaft fractures are commonly seen, comprised of 3%- 5% of all bony fractures. It has bimodal age distribution. Surgical stabilization can be achieved by dynamic compression plating (DCP) and intramedullary nailing (IMN). Present study was aimed to compare functional outcome of dynamic compression plating versus interlocking nailing for fracture shaft of humerus at tertiary care center. **Material and Methods:** Present study was hospital based, prospective and observational study, conducted in patients > 18years, either gender, with fresh, closed diaphyseal fractures of humerus. Depending on the level of fracture and nature of fracture, an appropriate implant, and surgical approach was selected as group P (plating) and group N (nailing). **Results:** During study period, total 42 patients satisfying study criteria were studied and were divided as group P (n=21) and group N (n=21). In present study mean age (years), gender (males/ females), laterality (right/left) and mode of injury were comparable among group P and group N, difference was not significant statistically (p>0.05). We noted statistically significant less duration of surgery, less average blood loss, reduced duration of hospital stay after surgery and less duration was noted for union in group N as compared to group P (p< 0.05). Complications, functional outcomes according to Rommen's criteria was graded at end of 1 year and Functional outcomes was comparable among group P and group N, difference was not significant statistically (p>0.05). **Conclusion:** In modern days interlocking nailing should be preferred over dynamic compression plating for fracture shaft of humerus as it is associated with less duration of surgery, less average blood loss, reduced duration of hospital stay and less duration for union.

Keywords: Interlocking nailing, dynamic compression plating, fracture shaft of humerus, union.

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INTRODUCTION

Humeral shaft fractures are commonly seen, comprised of 3%- 5% of all bony fractures. It has bimodal age distribution. It is mostly seen among young patients with high-energy trauma and in case of elderly it is usually seen among osteopenic patients with low-energy injuries.[1,2] Historically used methods of conservative treatment include skeletal traction, abduction cast, coaptation splint, velpeau dressing, and hanging arm cast. However, the incidence of non-union, malunion, residual angulation, limb length inequality and significant loss of function were shown to be high with non-operative management. Surgical stabilization can be achieved with different implants. Usual surgical modalities include dynamic compression plating (DCP) and intramedullary nailing (IMN).[3] Surgical treatment is generally indicated in patients in whom there is a failure to maintain stable alignment and reduction at the fracture site and in the

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patients with severe segmental fractures, open fractures, or fractures associated with bilateral fractures, forearm fractures on the same side, polytrauma, progressive neurological deficits, vascular injury or floating shoulder or elbow.[4]In a metaanalysis of randomized controlled trials, where plating was compared with IMN of humeral shaft fractures, it was found that the former has a low risk of complications and requires lesser clinical expertise.[5] However, some studies concluded that there is a higher risk of radial nerve damage and biomechanical failure after plating, due to extensive tissue damage.[6,7] Present study was aimed to compare functional outcome of dynamic compression plating versus interlocking nailing for fracture shaft of humerus at tertiary care center

MATERIAL AND METHODS

Present study was hospital based, prospective and observational study, conducted in Department of Orthopaedic, Sai Sanjeevni Hospital, Kothapeth Hyderabad, Telangana, INDIA. Study duration was of 3 years (July 2018 to June 2021). Ethical approval was taken from the Institutional Ethics Committee.

Inclusion criteria: Patients > 18years, either gender, with fresh, closed diaphyseal fractures of humerus

Exclusion criteria: All grades of compound fractures of shaft of humerus. Pathological / infected / un-united fractures. Proximal and Distal Humeral fractures having articular extensions. Medically unfit for surgery

On admission, patients were informed about the study, and written consent was taken for participation and follow up. Patients underwent detailed history taking and physical examination. X ray (Antero-Posterior and Lateral views.) of injured arm was done and diagnosis was confirmed. Patient's injured arm is immobilized in a plaster of Paris U- slab, analgesics were given. Pre-operative hematological and other investigations were done and patients were posted as early as possible. Written and informed consent was obtained from the patient for surgery.

Depending on the level of fracture and nature of fracture, an appropriate implant, and surgical approach was selected. All patients were operated under General Anaesthesia, under all aseptic precautions.

1. In group P (plating) - Broad and Narrow of 4.5mm DCP), length of plate, number of screws required (4.5mm) and the necessity of inter fragmentary screws (3.5mm /4.5 mm) were used. For plating, patient was placed in lateral decubitus position with arm supported on a bolster/arm board for Posterior approach/ Triceps splitting approach (for fractures distal third of the shaft and fractures associated with radial nerve deficit), Supine position for Anterior approach with arm on side board or by Anterolateral approach (Henry, for upper and middle third) fractures:
2. In group N (nailing) – various nails (length- 24cm, 26cm, 28cm and 30cm and diameter - 6mm, 7mm and 8mm), proximal and distal locking screws were used. Nailing was done in supine position with the head turned towards the contralateral side and a pillow was placed between the medial borders of scapulae; and was done by antegrade technique under the control of image intensifier.

Standard post-operative monitoring was done and wrist, finger movements were examined for any iatrogenic radial nerve injury. Sutures were removed on the 10th postop day and patient was discharged with the U-slab applied and arm supported in an arm pouch. Patient was instructed to review after 3 weeks at OPD followed by 6th week, 3rd month, 6th month and 1year.

At each visit, clinical examination (wound/scar, tenderness, movements of joints, NV status and radiological evaluation (evidence of union and status of the implant) was done and post-operative complications if any, noted. Shoulder and elbow functions were assessed by Rommen's criteria. Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Difference of proportions between qualitative variables were tested using chi- square test or Fisher exact test as applicable. P value less than 0.5 was considered as statistically significant.

RESULTS

During study period, total 42 patients satisfying study criteria were studied and were divided as group P (n=21) and group N (n=21). In present study mean age (years), gender (males/ females), laterality (right/left) and mode of injury were comparable among group P and group N, difference was not significant statistically (p>0.05).

Table 1: General characteristics

Patient characteristics	Group P (plating) (No. of patients/ Percentage)	Group N (nailing) (No. of patients/ Percentage)
Mean Age (years)	43.65 ± 11.3	39.12 ± 13.8
Gender (Males/ Females)	16 (76.19%)/ 5 (23.81%)	15 (71.43%)/ 6 (28.57%)
Laterality (Right/Left)	13 (61.90%)/ 8 (38.10%)	11 (52.38%)/ 10 (47.62%)

Mode of injury:		
RTA	13 (61.90 %)	12 (57.14 %)
Fall from height	5 (23.81 %)	4 (19.05 %)
Trivial trauma/ Others	3 (14.29 %)	5 (23.81 %)

We noted statistically significant less Duration of surgery, less Average blood loss and reduced Duration of hospital stay after surgery in group N as compared to group P ($p< 0.05$).

Table 2: Surgical Characteristics

Characteristics	Group N (nailing) (Mean ± SD)	Group P (plating) (Mean ± SD)	P value
Delay between admission and surgery (days)	3.4 ± 1.6	3.5 ± 1.3	0.84
Duration of surgery (mins)	48.54 ± 20.84	76.82 ± 25.45	0.034
Average blood loss (ml)	100.94 ± 31.56	259.54 ± 74.64	0001
Postoperative analgesics requirement (days)	4.3 ± 1.7	4.4 ± 2.2	0.85
Duration of hospital stay after surgery (days)	5.1 ± 2.6	7.0 ± 2.4	0.041

In present study, significant less duration was noted for union in group N as compared to group P ($p< 0.05$).

Table 3: Time taken for union

Time taken for union (weeks)	Group N (nailing) (No. of patients/ %)	Group P (plating) (No. of patients/ %)	P value
10- 12	15 (71.43 %)	12 (57.14 %)	0.043
13–15	4 (19.05 %)	6 (28.57 %)	
16–18	2 (9.52 %)	3 (14.29 %)	
Non-union	0	0	

In present study among group P, complications noted were Superficial wound Infection (9.52 %), Radial nerve injury (4.76 %), Implant failure (4.76 %) and Delayed union (4.76 %). While in group N complications noted were Shoulder stiffness (14.29 %), Elbow stiffness (4.76 %), Implant failure (4.76 %) and Delayed union (4.76 %). Complications were comparable among group P and group N; difference was not significant statistically ($p>0.05$).

Table 4: Post-op Complications

Type of Complication	Group P (plating) (No. of patients/ %)	Group N (nailing) (No. of patients/ %)	P value
Superficial wound Infection	2 (9.52 %)	0	0.063
Radial nerve injury	1 (4.76 %)	0	
Shoulder stiffness	0	3 (14.29 %)	
Elbow stiffness	0	1 (4.76 %)	
Implant failure	1 (4.76 %)	1 (4.76 %)	
Delayed union	1 (4.76 %)	1 (4.76 %)	

Functional outcomes according to Rommen's criteria was graded at end of 1 year and Functional outcomes was comparable among group P and group N, difference was not significant statistically ($p>0.05$).

Table 5: Functional outcomes according to Rommen's criteria

Grade	Range of motion (ROM)	Subjective Shoulder / elbow complaints	Group P (plating) (No. of patients/ %)	Group N (nailing) (No. of patients/ %)	P value
Excellent	$<10^0$ loss of ROM in any direction	None	16 (76.19 %)	16 (76.19 %)	
Moderate	Loss of ROM between 10^0- 30^0 in any direction	Mild	5 (23.81 %)	4 (19.05 %)	
Poor	Loss of ROM $>30^0$ in any direction	Moderate to Severe	0	1 (4.76 %)	

DISCUSSION

The majority of Humeral diaphyseal fractures used to be treated non-operatively before with predictably good rate of union and functional outcome, but prolonged immobilisation of the limb was needed resulting in delayed return to professional and recreational activities.[8] Major disadvantages of conservative treatment being a constant contraction of the surrounding muscles and the pull of gravity which tends to distract the fracture fragments, joint stiffness, edema, muscle atrophy, and osteoporosis.

Inadequate immobilization may lead to delayed union and non-union, whereas prolonged immobilization may lead to stiffness of elbow and shoulder joint.[9] Pansey NK *et al.*,[10] studied 43 patients with diaphyseal fracture humerus, treated with Intramedullary nailing and plating. The mean surgical time was 68 minutes in cases where nailing was done and 115 minutes in cases with plating (P <0.001). Radiological union was seen at 13±4.8 weeks and 15±3.9 weeks in the nailing and plating group respectively. There were 2 (9.09%) cases in the nailing group and 1 (4.7%) case in the plating group which had delayed union. 3 (13.6%) cases in the nailing group had post-operative shoulder stiffness. The mean ASES score at the end of one year was 31.3 in nailing and 29.6 in plating group (P =0.327). There were 37 (86.5%) cases with excellent to good results. Nailing and plating have equal functional outcomes in cases with shaft humerus fracture. Mir GR *et al.*[11] concluded IMIL nailing for shaft humerus fractures is an effective surgical option though there are high chances of shoulder related complications. Intramedullary interlocking nailing was also associated with significantly decreased blood loss than plating as stated by Chao *et al.*[12] Mohan KR *et al.*,[13] concluded that the transverse fractures of humerus shaft are better treated with ante grade intramedullary interlocking nail, and comminuted fracture shaft humerus and those fractures associated with neuro-vascular or soft tissue injuries are better treated with plating. The intramedullary interlocking nail can be considered a better surgical option for the management of humeral shaft fractures because it offers decreased intraoperative blood loss; shorter operative times, hospital stays, and union times; and a lower incidence of serious complications such as radial nerve palsy.[14] With the advent of rigid intramedullary nailing with transverse locking screws, the surgeons are now trying to couple the advantages of conservative management with the advantages of operative treatment.[15] Closed interlocking nailing involves minimal surgical intervention, biological fixation, no periosteal stripping with rotational and torsional stability, anatomical reduction, and early mobilization preservation of hematoma.[16] Plating demands extensive soft tissue dissection and periosteal stripping with a long operating time but can provide a more stable fixation, can reduce chances of malunion and it allows for direct visualization of the radial nerve. Hems and Bhullar suggested that antegrade nailing affects fracture healing by distracting the fracture and soft tissues.[17] Impairment of shoulder function is the main drawback of interlocking nailing. Shoulder pain in these patients may be related to violation of the rotator cuff, prominent nail end, adhesive capsulitis or unknown causes.[5] In present study, shoulder problems in 13.3 % of our patients. One patient with protruding nail required a second surgery for the removal of implant. Several studies have investigated different approaches to improve the outcomes by avoiding the avascular zone of the rotator cuff. These studies reported that careful repair of the tendon after nail insertion may provide better outcomes and less morbidity.[18,19] With the recent advances in medical field, some surgeons prefer IMN over plating, since IMN is less invasive and give greater mechanical stability.[20,21] IMN has the advantage of closed insertion techniques, intact periosteal blood supply, and load-sharing mechanical properties. The IMN can reduce the effects of stress shielding at the fracture site and lower the incidence of refracture after implant removal.[20]

CONCLUSION

Dilemma is common during treatment of fracture shaft of humerus. In modern days, interlocking nailing should be preferred over dynamic compression plating for fracture shaft of humerus as it is associated with less duration of surgery, less average blood loss, reduced duration of hospital stay and less duration for union.

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