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Original Research Article

Comparative study between interlock nailing and dynamic compression plating in humerus diaphyseal fractures in its functional and surgical outcome

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ABSTRACT

Background: The aim of the study was to analyse compare study between interlock nailing and dynamic compression plating in humerus diaphyseal fractures in its functional and surgical outcome.
Methods: The 2019 to 2022, patients were randomly divided into two groups with the help of computer-generated coded envelopes, group A (humerus diaphyseal fractures treated with dynamic compression plating) and group B (humerus diaphyseal fractures treated with interlock nailing) with 20 patients in each group. Outcomes were evaluated based on operative time, blood loss, neurovascular deficit, surgical site infection, union, shoulder stiffness, constant Murley score, Mayo elbow performance index at 1 year of follow up.
Results: On radiology as non-union and union, most common study participants show union, on follow up of 1 year constant Murley score and Mayo elbow performance index was calculated and constant Murley score was more in patients treated with dynamic compression plating, shoulder stiffness was more in patients treated with interlock nailing. However blood loss was more in patients treated with dynamic compression plating.
Conclusions: The result of our study shows that interlock nailing is associated with less blood loss but it is associated with decreased shoulder function postoperatively and marked shoulder stiffness which is more than patients treated with dynamic compression plating. Hence dynamic compression plating should be considered gold standard for operative treatment of humerus shaft fracture.

Keywords: Dynamic compression plating, Interlock nailing, Mayo elbow performance index, Constant Murley score

INTRODUCTION

Fractures of humerus shaft constitute 1% to 13-14% of all fractures occurring in human body.[1] Little has changed in the non-operative treatment of diaphyseal humeral fractures since previous times, as humerus fractures heal within a short span of time.[2] During the treatment, patients are mobile and the shoulder and elbow joints compensate for residual malalignment.[3] However, patients in modern times demand faster union rates and earlier return to preinjury activities while preserving functionally and motion of nearby joints.[4] Therefore over the last few decades, there have been significant advances in field of surgical management of humerus diaphyseal fractures.[5] The treatment method for this fracture includes conservative methods like sling/swathe and velpau bandage, U slab, hanging cast, functional bracing.[6] Operative techniques are plate osteosyntheis, interlock nailing and external fixation.[7] The goal of operative treatment of humerus fracture is to obtain reduction of fracture and allow early weight bearing and early range of motion of shoulder and elbow of injured

extremity. Plate osteosyntheis requires extensive soft tissue stripping and dissection and there is chances of neurovascular injury and infection. Plate osteosynthesis has shown to have high union rate.[8] Whereas intramedullary nailing is a closed procedure and doesn't require extensive dissection and soft tissue stripping.[9] Study is intended to compare between functional and surgical outcome in patients treated by dynamic compression plating and interlock nailing.

METHODS

From hospital settings on admitted cases of Department of Orthopedics in Tertiary Care Centre and Government Medical College.

Study design

This was an interventional prospective randomised control trial study.

Period of study

The study was carried out over 3 years from June 2019 to June 2022.

Study place

The study place was tertiary care centre and Government Medical College, Department of Orthopaedics, Lokamanya Tilak Government Medical College.

Software used Software used was SPSS (Stastical package for social sciences).

Ethics committee

The study was approved by institutional ethics committee.

Sample size

Patients were randomly divided into two groups with the help of computer-generated coded envelopes; group A (humerus diaphyseal fractures treated with dynamic compression plating) and group B (humerus diaphyseal fractures treated with interlock nailing with 20 patients in each group.

Inclusion criteria

Patients with humerus shaft fractures treated with standard surgical techniques; and those with age above 18 years were included.

Exclusion criteria

Patients with other fracture in same limb; those with age above 80 years; with open wound on arm associated with humerus diaphyseal fracture on same arm; and with neurovascular injury preoperatively were excluded.

Management protocol

Patient prepared on the morning of day of surgery. Single dose preoperative antibiotic given after test dose. Patient is operated under all aseptic precautions with pre-operative consent.

Patient operated with dynamic compression plating

Under suitable anaesthesia, the patient is placed either in prone position with the arm 90° and the elbow allowed to bend and the forearm to hang over the side of the table or in lateral position with the affected side uppermost.[4] A longitudinal skin incision is placed in the midline of the posterior aspect of the arm, from 9 cm below the acromion to the olecranon fossa.[7] The dissection is carried down to the fascia of triceps and then fascia is incised. The radial nerve is identified and freed distally as well as proximally to allow for mobilization.[11] The triceps muscle is identified and is stripped off the periosteum and the fracture site is exposed. The fracture ends are freshened and the fragments are reduced and held with bone clamps or with a lag screw and then dynamic compression plate is applied.[15]

Patient operated with interlock nailing

Under suitable anaesthesia, the patient is positioned supine on a fracture table with a sand bag under the ipsilateral shoulder and the whole upper limb is prepared and drapped to keep the limb free.[8] Through lateral deltoid splitting approach with the image intensifier the entry point is made just medial to the greater tuberosity of proximal humerus and in the area at junction between the articular surface of the head of humerus and greater tuberosity with a k-wire and passed into the medullary canal.[9] After splitting the deltoid, the Rotator cuff is exposed and at the tendon of the supraspinatus is splitted.[14] The entry point reamer is passed over the k-wire and is enlarged 0.45 cm guide wire is introduced through the entry point and is passed into the distal fragment from proximal fragment after reducing the fracture closed and under the guidance of C-arm image intensifier. Progressive reaming was done over the guide wire upto 1 mm more than the desired size of nail.[11] The appropriate nail is mounted on the zig and inserted through the guide wire maintaining the reduction. The nail size should be carefully selected because over sized nail can splinter the distal fragment. The nail is pushed so that the nail is not protruding out through the proximal humerus[16]. The distal locking are antero-posterior locking. Under image guidance a stab incision is made at the anterior aspect of arm, the brachailis and biceps is split to expose the surface of the bone.[19] Under image intensifier appropriate drill bit is used and the distal screws are inserted. Proximal locking is done by use of proximal jig that is mounted with the nail. Care must be used to avoid injury to

axillary nerve. The proximal locking is done from lateral to medial plane.[16]

RESULTS

A prospective observational study carried out over 6 months in a tertiary care centre and Government Medical College on 40 patients where they were randomly divided into two groups with the help of computer- generated coded envelopes; group A (humerus diaphyseal fractures treated with dynamic compression plating) and group B (humerus diaphyseal fractures treated with interlock nailing) with 20 patients in each group.

In our study total 40 patients were included and mean age of patients was 37.45±13.78. In our study of 40 patients 13 (32.5%) were female and 27 (67.5%) were male. In our study of 40 patients 16 (40%) were left sided and 24 (60%) were right sided fracture.

In our study of 40 patients blood loss was 245±34.25 in dynamic compression plating and 80.50±21.39 in interlock nailing. 4 (20%) of patients operated by dynamic compression plating had blood loss between 100-200, 16 (80%) of patients operated by dynamic compression plating had blood loss >200, 16 (80%) of patients operated by interlock nailing had blood loss <100, 4 (20%) of patients had blood loss between 100-200.There was significant difference in blood loss between interlock nailing and dynamic compression plating with p value <0.0001.

In our study of 40 patients mean operative time was 143.35±15.45 in dynamic compression plating and 138.55±13.72 in interlock nailing. 2 (10%) of patients operated by dynamic compression plating had operative time <120, 11 (55%) patients operated by dynamic compression plating had operative time 120-150, 7 (35%) of patients operated by dynamic compression plating had operative time >150. 3 (15%) of patients operated by interlock nailing had operative time <120, 13 (65%) of patients operated by interlock nailing had operative time 120-150, 4 (20%) of patients operated by interlock nailing had operative time >150. No significant difference was found in operative time in two groups with p value 0.553.

In our study of 40 patients constant Murley score was 92.50±2.92 in patients treated by dynamic compression plating and 86.35±5.61 in patients treated by interlock nailing after 1 year. 4 (20%) of patients operated by dynamic compression plating had constant Murley score 81-90, 16 (80%) of patients operated by dynamic compression plating had constant Murley score >90. 5 (25%) of patients operated by interlock nailing had constant Murley score of <80, 11 (55%) of patients operated by interlock nailing had constant Murley score 81-90, 4 (20%) of patients operated by interlock nailing had constant Murley score >90. There was significant difference in constant Murley score between dynamic compression plating and interlock nailing with p value <0.001.

In our study of 40 patients, Mayo elbow performance index was 91.75±4.66 in patients treated by dynamic compression plating and 92.00±4.70 in patients treated by interlock nailing after 1 year. 11 (55%) of patients treated by dynamic compression plating had Mayo elbow performance index <90, 7 (35%) of patients treated by dynamic compression plating had Mayo elbow performance index 91-95, 2 (10%) of patients treated by dynamic compression plating had Mayo elbow performance index 96-100. 12 (60%) of patients treated by interlock nailing had Mayo elbow performance index <90, 5 (25%) of patients treated by interlock nailing had Mayo elbow performance index 91-95, 3 (15%) of patients treated by interlock nailing had Mayo elbow performance index 96-100. There was no significant difference in Mayo elbow performance index between two groups with p value =0.749.

In our study of 40 patients, 18 (90%) of patients treated by dynamic compression plating had union after 1 year, 2 (10%) of patients treated by dynamic compression plating had non-union after 1 year. 17 (85%) of patients treated by interlock nailing had union after 1 year, 3 (15%) of patients treated by interlock nailing had non-union after 1 year.

In our study of 40 patients, shoulder stiffness was present in 1 (5%) of patients treated by dynamic compression plating whereas 19 (95%) of patients treated by dynamic compression plating didn't had shoulder stiffness. 6 (30%) of patients treated by interlock nailing had shoulder stiffness whereas 14 (70%) of patients treated by interlock nailing didn't had shoulder stiffness. There was significant difference in shoulder stiffness between dynamic compression plating and interlock nailing with p value =0.037. In our study of 40 patients, 1 (5%) of patients operated by dynamic compression plating had neurovascular deficit, 19 (95%) of patients operated by dynamic compression plating did not had neurovascular deficit whereas no neurovascular deficit was documented.

Table 1: Distribution of study subjects according to the age (n=40).

Age (years)	N	%
≤30	19	47.5
31-40	9	22.5
41-50	2	5.0
51-60	7	17.5
>60	3	

Table 2: Distribution of study subjects according to the gender (n=40).

Gender	N	%
Female	13	32.5
Male	27	67.5

Table 3: Distribution of study subjects according to the side (n=40).

Side	N	%
Left	16	40.0
Right	24	60.0

Table 4: Distribution of blood loss between study groups (n=40).

Blood loss (ml)	Group, N (%)	
	Dynamic compression plating (n=20)	**Inter-lock nailing (n=20)**
≤100		16 (80.0)
100-200	4 (20.0)	4 (20.0)
>200	16 (80.0)	
Mean (SD)	245.00 (34.25)	80.50 (21.39)

Note: Chi-square test, p<0.001, significant.

Table 5: Comparison of operative time between study groups (n=40).

Operative time (min)	Group, N (%)	
	Dynamic compression plating (n=20)	**Inter-lock nailing (n=20)**
≤120	2 (10.0)	3 (15.0)
120-150	11 (55.0)	13 (65.0)
>150	7 (35.0)	4 (20.0)
Mean (SD)	143.35 (15.45)	138.55 (13.72)

Note: Chi-square test, p=0.553, not significant.

Table 6: Comparison of operative time between study groups (n=40).

Constant Murley score	Group, N (%)	
	Dynamic compression plating (n=20)	**Inter-lock nailing (n=20)**
≤80		5 (25.0)
81-90	4 (20.0)	11 (55.0)
>90	16 (80.0)	4 (20.0)
Mean (SD)	92.50 (2.92)	86.35 (5.61)

Note: Chi-square test, p<0.001, significant.

Table 7: Mayo elbow performance index between study groups (n=40).

Perfor-mance index	Group, N (%)	
	Dynamic compression plating (n=20)	**Inter-lock nailing (n=20)**
≤90	11 (55.0)	12 (60.0)
91-95	7 (35.0)	5 (25.0)
96-100	2 (10.0)	3 (15.0)
Mean (SD)	91.75 (4.66)	92.00 (4.70)

Note: Chi-square test, p=0.749, not significant.

Table 8: Comparison of union between study groups (n=40).

Union	Group, N (%)	
	Dynamic compression plating (n=20)	**Inter-lock nailing (n=20)**
Present	18 (90.0)	17 (85.0)
Absent	2 (10.0)	3 (15.0)

Note: Chi-square test, p=0.553, not significant.

Table 9: Comparison of shoulder stiffness between study groups (n=40).

Union	Group, N (%)	
	Dynamic compression plating (n=20)	**Inter-lock nailing (n=20)**
Present	1 (5.0)	6 (30.0)
Absent	19 (95.0)	14 (70.0)

Note: Chi-square test, p=0.553, not significant.

Table 10: Comparison neuro-vascular deficit between study groups (n=40).

Neuro-vascular deficit	Group, N (%)	
	Dynamic compression plating (n=20)	**Inter-lock nailing (n=20)**
Present	1 (5.0)	
Absent	19 (95.0)	20 (100.0)

Note: Chi-square test, p=0.311, not significant.

Figure 1: Case 1- 22 years old male with H/O RTA presented to tertiary hospital came with C/O pain and swelling in arm with no DNVD (a) at presentation; (b) immediate post-op.

Figure 2: Intra-operative picture.

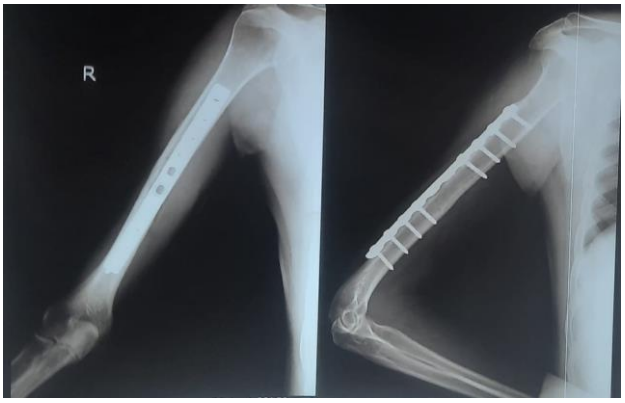

Figure 3: After 1 year follow-up.

DISCUSSION

In comparison between two groups, dynamic compression plating and interlock nailing in humerus shaft fracture, the following factors taken into account age, sex, side, blood loss, operative time, surgical site infection, neurovascular deficit, shoulder stiffness, union, constant Murley score and mayo elbow performance index for shoulder and elbow function respectively.

In my study humerus shaft fracture patients operated in year 2019-2021 by interlock nailing or dynamic compression plating in tertiary care hospital in Maharashtra were followed prospectively.

Age

In my study, 40 patients were divided into two groups by mode of treatment modality one with interlock nailing and other with dynamic compression plating and only patients with age 18-80 were studied.

In my study of 40 patients, 19 (47.5%) were in age group of <30, 9 (22.5%) were in age group of 31-40, 2 (5%) were in age group of 41-50, 7 (17.5%) were in age group of 51-60, 3 (7.5%) were in age group of >60 with average age of 37.45±13.78.

Nehate et al in their comparative study between dynamic com-pression plating versus interlock nailing in treatment of fracture of humerus shaft in year 2021 found that 32 (73%) patients were in age group of 3rd and 4th decade 12 (27%) patients were above 40 years.[3]

Sex

In my study of 40 patients, 27 (67.5%) were male and 13 (32.5%) were female.

Modi et al in their study of comparative study of functional outcome of dynamic compression plating with intramedullary interlock nailing in close fracture of humerus in adults in year 2015 found that 37 (77%) were male and 11 (23%) were female.[2]

Side

In our study of 40 patients, 16 (40%) patients had left side fracture and 24 (60%) patients had right side fracture.

Singh et al in their comparative study of compression plating verses interlock nail in fracture shaft of humerus in year 2016 found that fracture was more common on right side with 63.33% cases of right side.[1]

Operative time

In our study of 40 patients mean operative time was 143.35±15.45 in dynamic compression plating and 138.55±13.72 in interlock nailing. 2 (10%) of patients operated by dynamic compression plating had operative time <120, 11 (55%) patients operated by dynamic compression plating had operative time 120-150, 7 (35%) of patients operated by dynamic compression plating had operative time >150. 3 (15%,) of patients operated by interlock nailing had operative time <120, 13 (65%) of patients operated by interlock nailing had operative time 120-150, 4 (20%) of patients operated by interlock nailing had operative time >150. No significant difference was found in operative time in two groups with p value =0.553

Nehate et al in their comparative study between dynamic compression plating versus interlock nailing in treatment of fracture of humerus shaft in year 2021 found that operative time was 123.8 mins for plating versus 58.4 mins for nailing as plating requires extensive dissection. There was statistically significant difference.[3]

Blood loss

In our study of 40 patients blood loss was 245±34.25 ml in dynamic compression plating and 80.50±21.39 ml in interlock nailing. 4 (20%) of patients operated by dynamic compression plating had blood loss between 100-200, 16 (80%) of patients operated by dynamic compression plating had blood loss >200, 16 (80%) of patients operated by interlock nailing had blood loss <100, 4 (20%) of patients had blood loss between 100-200. There was

significant difference in blood loss between interlock nailing and dynamic compression plating with p value <0.0001. Kulkarni et al in their study antegrade interlocking nailing vs dynamic compression plating for humeral shaft fractures in 2012 found that mean blood loss was 20 ml for interlock nailing and 232 ml in dynamic compression plating which was statistically significant with p value <0.001.[6]

Union

In our study of 40 patients, 18 (90%) of patients treated by dynamic compression plating had union after 1 year, 2 (10%) of patients treated by dynamic compression plating had non-union after 1 year. 17 (85%) of patients treated by interlock nailing had union after 1 year, 3 (15%) of patients treated by interlock nailing had non-union after 1 year.

Modi et al in their study of comparative study of functional outcome of dynamic compression plating with intramedullary interlock nailing in close fracture of humerus in adults in year 2015 found that incidence of non-union in DCP was 0% whereas incidence of non-union in interlock nailing was 7.7%.[2]

Neurovascular deficit

In our study of 40 patients, 1 (5%) of patients operated by dynamic compression plating had neurovascular deficit, 19 (95%) of patients operated by dynamic compression plating did not had neurovascular deficit whereas no neurovascular deficit was documented in interlock nailing patients.

Naveen et al in their comparative study between the dynamic compression plating and the intramedullary interlock nailing in diaphyseal fractures of the humerus in adults in year 2013 found that the incidence of postoperative radial nerve palsy was 0% in DCP group whereas in interlocking group 2 patients had neuropraxia which recovered gradually.[5]

Shoulder stiffness

In our study of 40 patients, shoulder stiffness was present in 1 (5%) of patients treated by dynamic compression plating whereas 19 (95%) of patients treated by dynamic compression plating didn't had shoulder stiffness. 6 (30%) of patients treated by interlock nailing had shoulder stiffness whereas 14 (70%) of patients treated by interlock nailing didn't had shoulder stiffness.There was significant difference in shoulder stiffness between dynamic compression plating and interlock nailing with p value 0.037.

Singh et al in their comparative study of compression plating vs interlock nail in fracture shaft of humerus in year 2016 found that 10 patients in interlock nailing had shoulder stiffness with no patient in dynamic compression plating, showing statistical significant difference.[1]

Constant Murley score and mayo elbow performance score

In our study of 40 patients constant Murley score for shoulder function was 92.50±2.92 in patients treated by dynamic compression plating and 86.35±5.61 in patients treated by interlock nailing after 1 year. 4 (20%) of patients operated by dynamic compression plating had constant Murley score 81-90, 16 (80%) of patients operated by dynamic compression plating had constant Murley score >90. 5 (25%) of patients operated by interlock nailing had constant Murley score of <80, 11 (55%) of patients operated by interlock nailing had constant Murley score 81-90, 4 (20%) of patients operated by interlock nailing had constant Murley score >90. There was significant difference in constant Murley score between dynamic compression plating and interlock nailing with p value <0.001.

In our study of 40 patients, Mayo elbow performance index for elbow function was 91.75±4.66 in patients treated by dynamic compression plating and 92.00±4.70 in patients treated by interlock nailing after 1 year. 11 (55%) of patients treated by dynamic compression plating had Mayo elbow performance index <90, 7 (35%) of patients treated by dynamic compression plating had Mayo elbow performance index 91-95, 2 (10%) of patients treated by dynamic compression plating had Mayo elbow performance index 96-100. 12 (60%) of patients treated by interlock nailing had Mayo elbow performance index <90, 5 (25%) of patients treated by interlock nailing had Mayo elbow performance index 91-95, 3 (15%) of patients treated by interlock nailing had Mayo elbow performance index 96-100.There was no significant difference in Mayo elbow performance index between two groups with P value 0.749. Kulkarni et al in their study antegrade interlocking nailing vs dynamic compression plating for humeral shaft fractures in 2012 found that mean American shoulder and elbow performance score for nailing was 31.4 and for plating it was 29.04.[6] Nehate et al in their comparative study between dynamic compression plating versus interlock nailing in treatment of fracture of humerus shaft in year 2021 found that there was no significant difference as per functional outcome assessed by American shoulder and elbow surgeons scores and range of motion after 8 months followup in both groups.[3]

Limitations

There were a few limitations in our study. Firstly, it is not randomized and not double blinded. Secondly, power of the study is inadequate. Third, implant used were the same in all patients.

CONCLUSION

We included 40 patients in our study, and prospectively studied them for 1 year after surgery and taken various parameters into consideration. Majority of patients were of age less than 30 years and male were more affected than

females. Right side fracture was more common than left. Operative time, blood loss and union was more for dynamic compression plating. Neurovascular deficit of interlock nailing was less as compared to dynamic compression plating. Constant Murley score was more in dynamic compression plating which was statistically more significant with marked shoulder stiffness in patients treated with Interlock nailing suggestive of decreased shoulder function postoperatively in patients of interlock nailing. Mayo elbow performance score was more in dynamic compression compression plating which was statistically not significant.

Recommendations

Hence dynamic compression plating should be considered gold standard for operative treatment of humerus shaft fracture.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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