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Original Research Article

A Comparative Analysis of the Functional and Surgical Outcomes of Interlock Nailing and Dynamic Compression Plating in the Treatment of Humerus Diaphyseal Fractures

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Abstract

Aim: A comparative analysis of the functional and surgical outcomes of interlock nailing and dynamic compression plating in the treatment of humerus diaphyseal fractures.

Material and Methods: This was an interventional retrospective randomized study was conducted in the Department Of orthopedics, SKMCH, Muzaffarpur, Bihar, India for one year. 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. Patients with humerus shaft fractures treated with standard surgical techniques; and those with age above 18 years were included.

Results: 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.

Conclusion: 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 plating which was statistically not significant.

Keywords: Iinterlock, Nailing, Dynamic Compression Plating, Humerus Diaphyseal Fractures.

Introduction

Humerus diaphyseal fractures are a common orthopaedic injury, constituting approximately 3% of all fractures. These fractures can result from high-energy trauma, such as motor vehicle accidents or falls from a height, or from low-energy mechanisms, particularly in osteoporotic bones. The management of these fractures has evolved significantly over the years, with various surgical techniques being employed to optimize functional outcomes and minimize complications. Interlock nailing and dynamic compression plating (DCP) are two widely used surgical techniques for the fixation of humeral shaft fractures. Interlock nailing involves the insertion of an intramedullary nail into the medullary cavity of the humerus, which is then locked at both ends with screws to prevent rotational and axial movements. [1-6] This technique offers several advantages, including minimal soft tissue disruption, preservation of the periosteal blood supply, and a biomechanically stable construct that can facilitate early mobilization of the shoulder and elbow. [7-12] Additionally, interlock nailing is particularly beneficial for fractures located in the middle third of the humerus and for pathological fractures. On the other hand, dynamic compression plating involves the application of a plate along the surface of the bone, which is then secured with screws. This method provides rigid fixation and allows for accurate anatomical reduction of the fracture fragments. DCP is especially advantageous

for fractures that are comminute or located at the proximal or distal ends of the humerus, where intramedullary nailing may be challenging. Moreover, DCP can be used in cases where there is a need for immediate functional use of the limb, as it provides a stable fixation that can withstand early loading. [13-16] Despite the effectiveness of both techniques, there is ongoing debate regarding the optimal surgical approach for humeral shaft fractures. Some studies suggest that interlock nailing may be associated with a higher incidence of shoulder pain and stiffness due to proximal screw irritation or rotator cuff impingement. Conversely, dynamic compression plating has been linked to a higher risk of radial nerve injury, which can result in significant functional impairment. The choice between interlock nailing and dynamic compression plating often depends on various factors, including the location and pattern of the fracture, the patient's overall health and activity level, and the surgeon's experience and preference. Understanding the relative benefits and potential complications of each technique is crucial for optimizing patient outcomes and minimizing morbidity associated with humeral diaphyseal fractures. In this context, the present study aims to compare the clinical outcomes, complication rates, and functional results of interlock nailing versus dynamic compression plating in the treatment of humeral diaphyseal fractures. By analysing the advantages and drawbacks of each method, this research seeks to provide evidence-based recommendations for the management of these common orthopaedic injuries . [17-21]

Material and Methods

This was an interventional retrospective randomized study was conducted in the Department Of orthopedics, Skmch, Muzaffarpur, Bihar, India for one year. 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. Patients with humerus shaft fractures treated with standard surgical techniques; and those with age above 18 years were included. 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.

Methodology

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. Under suitable anesthesia, 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 s k in 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] Under suitable anesthesia, 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 draped 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 oversized 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 brachialis 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 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 have shoulder stiffness. 6 (30%) of patients treated by interlock nailing had shoulder stiffness whereas 14 (70%) of patients treated by interlock nailing didn't have 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).

Group, N (%)		
Blood loss (ml)	**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).

Group, N (%)		
Operative time (min)	**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).

Performances 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)

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.

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 by interlock nailing or dynamic compression plating were followed prospectively. 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 found that 32 (73%) patients were in age group of 3rd and 4th decade 12 (27%) patients were above 40 years.[3] 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] 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] 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] 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] 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] 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] 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 have 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] 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 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 follow-up in both groups.[21]

Conclusion

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 plating which was statistically not significant.

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