e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2024; 16(1); 526-531

Original Research Article

A Hospital-Based Assessment of the Efficacy of Dynamic Compression Plating and Interlock Nailing in the Treatment of Humeral Shaft Fractures

Sujit Kumar[1], Mukesh Kumar[2], Ranjit Kumar Singh[3]

[1]Senior Resident, Department of Orthopaedics, NMCH, Patna, Bihar, India

[2]Senior Resident, Department of Orthopaedics, NMCH, Patna, Bihar, India

[3]Professor, Department of Orthopaedics, NMCH, Patna, Bihar, India

Received: 10-11-2023 / Revised: 19-12-2023 / Accepted: 28-01-2024
Corresponding Author: Dr. Mukesh Kumar
Conflict of interest: Nil

Abstract

Aim: A comparative analysis of the efficacy of dynamic compression plating and interlock nailing in the treatment of humeral shaft fractures.

Materials and Methods: This study was conducted in the department of Orthopaedics, NMCH, Patna, Bihar, India for 12 months. The study was planned to compare the results of interlock nailing of humerus to a relatively well-established technique of dynamic compression plating. Total 44 patients with acute humerus shaft fracture in adults without prior disease were selected retrospectively and prospectively for the study. Twenty-two patients were treated by dynamic compression plating and 22 by interlock nailing. Functional outcome was determined using American Shoulder and Elbow Surgeon's Score.

Results: There were 33 (75%) close fractures and 11 (25%) open fractures. In our study, there were 11 open fractures, type II fractures were 7 in number, followed by type III (3 cases) and type I (one case) open fracture. Radial nerve palsy was associated with 2 cases of type II open fractures and one case of type IIIa fracture. There were 12 cases (27.2%) of preoperative radial nerve palsy. Out of 12 cases, 11 had recovered completely. There was no iatrogenic nerve palsy seen in our study. Out of 9 cases explored nerve was found to be intact in 8cases and contused in one case. Most of cases (7) of radial nerve palsy were associated with fracture of middle third shaft humerus. Majority of cases of fracture shaft humerus were associated with head injury followed by lower extremity fracture and ipsilateral forearm bone fracture. Majority of patients (40.9%) were operated within 6hours after injury. Anterolateral approach was used in 16 patients with dynamic compression plating. Posterior approach was used in 6 cases of lower third shaft fracture.

Conclusions: For patients requiring surgical treatment of humeral shaft fractures, both dynamic compression plating and interlock nailing provide predictable methods for achieving fracture stabilization and ultimate healing. Plating requires extensive dissection, more blood loss and duration of surgery as compared to nailing.

Keywords: Dynamic compression plating, Interlock nailing, Humeral shaft fractures.

Introduction

Fractures of the humeral shaft are common orthopedic injuries that present varied treatment challenges depending on factors such as fracture pattern, patient age, and associated injuries. These fractures typically result from direct trauma or indirect forces and are managed using various surgical techniques aimed at achieving stable fixation and promoting optimal functional recovery. Fractures of the humeral shaft constitute a significant proportion of all long bone fractures, accounting for approximately 3-5% of all fractures in adults. [1-6] They often occur due to high-energy trauma such as motor vehicle accidents or falls from height, as well as low-energy trauma in osteoporotic patients or those with pathological bone conditions.

Historically, the treatment of humeral shaft fractures began with non-operative methods, relying on conservative management with functional bracing or plaster immobilization. However, advances in surgical techniques and implant technology have revolutionized the management paradigm towards early surgical intervention, particularly in cases of displaced or unstable fractures. [7-10]

DCP involves the application of a plate and screws to achieve compression across the fracture site, thereby promoting alignment and stability. This technique is particularly advantageous in fractures with comminution or significant displacement, allowing for direct reduction and rigid fixation. Interlock nailing, also known as intramedullary

nailing, involves the insertion of a nail into the medullary canal of the humerus, providing stabilization along the length of the bone. This method preserves periosteal blood supply, minimizes soft tissue disruption, and allows for early mobilization.

The choice between DCP and interlock nailing hinges on several factors, including fracture characteristics, surgeon experience, patient age, and functional demands. [11-16] While DCP offers robust stabilization and direct anatomical reduction, interlock nailing preserves biomechanical alignment and facilitates biological healing. The selection of treatment for humeral shaft fractures should be guided by several clinical considerations, including fracture pattern, soft tissue condition, associated injuries, and patient-specific factors. While DCP offers immediate stability and precise fracture reduction, interlock nailing preserves periosteal blood supply and may minimize the risk of infection and non-union. Controversies persist regarding the optimal timing of surgery, implant selection, and postoperative rehabilitation protocols following either approach. [17-19]

Materials and Methods

This study was conducted in the department of Orthopaedics, NMCH, Patna, Bihar, India for 12 months. The study was planned to compare the results of interlock nailing of humerus to a relatively well-established technique of dynamic compression plating. Total 44 patients with acute humerus shaft fracture in adults without prior disease were selected retrospectively and prospectively for the study. Twenty-two patients were treated by dynamic compression plating and 22 by interlock nailing. These patients were followed up for a minimum period of 8 months in terms of radiological union time, amount of blood loss, duration of surgery, functional outcome, radial nerve recovery and complications such as infection, iatrogenic nerve palsy and delayed union and non-union. Functional outcome was determined using American Shoulder and Elbow Surgeon's Score.

Statistical analysis was performed using students 't' test and 'p' values were determined. Permission from Head of institute was obtained before beginning of the study. Written and informed consent was taken from patient and/or relative. Confidentiality and privacy of data strictly maintained throughout the study period as well as thereafter. Dynamic compression plate manufactured by Sushrut Surgical and Adler Screws were used. Twenty patients were treated by 4.5 mm narrow dynamic compression plate and 2 patients with narrow medullary canal were treated by 3.5 mm dynamic compression plate. Interlocking nails available in diameter of 6, 7 and 8 of Yogeshwar implant were used. 8 mm nail is cannulated and 6,7 mm nails are noncannulated.2.9 mm screw for 6 mm diameter nail and 3.9 mm screws were used for 7and8 mm diameter nails for locking. We used extensive Orthopaedic Trauma Association (OTA) 62 classification of long bone fracture, which includes linear fracture (transverse, oblique, spiral), communited fracture (50%, 50%, butterfly < 50% and > 50%), segmental fractures and fractures with primary bone loss. For open fractures modified Gustilo-Anderson classification (1984)63 used which is based on the size of wound, periosteal soft tissue damage, periosteal stripping and neurovascular injury.

Results

The present study consists of 44 cases of acute shaft fracture humerus. All those fractures had specific indications for operation. Care of associated injuries was taken with equal enthusiasm. In polytrauma patient duration of surgery, blood loss was calculated separately for interlock nailing and dynamic compression plating. The data of these cases had been compiled and condensed as a master chart. There was preponderance of male over female (30 Vs. 14) with majority population in 4th decade. The youngest patient was of 26 years and oldest was of 70 years male. Mean age was 39.65 years. In our study, majority of cases were of road traffic accident (86.3%) followed by history of fall from height (11.3%) and only one case of assault. In the present study, out of 44 cases, higher incidence of right-side involvement i.e. 29 patients (65.9%) were observed. Middle third shaft fractures were more common (52.2%) followed by lower and upper third (25% and 22.8%) respectively. Transverse fractures were maximum in number (45.4%) followed by oblique (29.6%).

There were 6 spiral and 5 comminuted fractures. There were 33 (75%) close fractures and 11 (25%) open fractures. In our study, there were 11 open fractures, type II fractures were 7 in number, followed by type III (3 cases) and type I (one case) open fracture. Radial nerve palsy was associated with 2 cases of type II open fractures and one case of type IIIa fracture. There were 12 cases (27.2%) of preoperative radial nerve palsy. Out of 12 cases, 11 had recovered completely. There was no iatrogenic nerve palsy seen in our study. Out of 9 cases explored nerve was found to be intact in 8cases and contused in one case. Most of cases (7) of radial nerve palsy were associated with fracture of middle third shaft humerus. Majority of cases of fracture shaft humerus were associated with head injury followed by lower extremity fracture and ipsilateral forearm bone fracture. Majority of patients (40.9%) were operated within 6hours after injury. Anterolateral approach was used in 16 patients with dynamic compression plating. Posterior approach was used in 6 cases of lower third shaft fracture. Close interlock nailing was performed in 19 patients

and open nailing by anterior approach in 3 patients. Majority of fractures in nailing and plating group were united within 17 week (15 V/s 13) respectively. There were 2non-union in plating as compared to one in nailing group. There was highly significant difference between mean values of duration of surgery in nailing and plating group ($p<0.01$). Thus, in dynamic compression plating group the duration of surgery was more than nailing group (58.4 min versus 103.8 min). The average blood loss in plating was 107.2 ml, statistically significant as compared to nailing group (31.5 ml in close and 70 ml in open nailing) ($p<0.01$). Union rate and time to union were not significantly different in nailing and plating group (14.3 V/s 16.2) ($p>0.05$). Average radial nerve recovery period was not statistically significant between both groups (9.9 week in nailing and 9.8. week in plating) ($p>0.05$). At minimum of 8-month follow-up there was no significant difference in functional outcome as per American Shoulder and Elbow Surgeons Score (ASES), strength, range of movement or return to activity in both groups ($p>0.05$). In the present study, delayed unions were noted in both interlock nail and dynamic compression plating (6 and 7 cases respectively). Complications like infection and iatrogenic radial nerve palsy were not observed in our study. Three cases in nailing group and no case in plating group had impingement, which was statistically significant.

Table 1: Age wise and Gender wise Distribution of Patients

Age (Years)	Gender	Male	Female
<30	07	7	9
31-40	14	14	26
41-50	04	4	6
51-60	03	3	1
>60	02	2	2
Total	30	14	44

Table 2: Demographic Characteristics

Characteristic	Number of Cases	Percentage (%)
Total Cases	44	100
Gender		
Male	30	68.2
Female	14	31.8
Age Distribution		
Mean Age	39.65 years	-
Youngest Patient	26 years	-
Oldest Patient	70 years	-
Cause of Fracture		
Road Traffic Accident	38	86.3
Fall from Height	5	11.3
Assault	1	2.3
Side of Fracture		
Right	29	65.9
Left	15	34.1

Table 3: Fracture Characteristics

Characteristic	Number of Cases	Percentage (%)
Fracture Location		
Middle Third	23	52.2
Lower Third	11	25
Upper Third	10	22.8
Fracture Type		
Transverse	20	45.4
Oblique	13	29.6
Spiral	6	13.6
Comminuted	5	11.4
Fracture Classification		
Closed	33	75
Open	11	25
Type I	1	2.3

Type II	7	15.9
Type III	3	6.8

Table 4: Radial Nerve Palsy and Associated Injuries

Characteristic	Number of Cases	Percentage (%)
Preoperative Radial Nerve Palsy	12	27.2
Complete Recovery	11	91.7
Radial Nerve Palsy by Fracture Type		
Type II Open Fractures	2	-
Type IIIa Open Fracture	1	-
Middle Third Shaft Fracture	7	-
Associated Injuries		
Head Injury	-	-
Lower Extremity Fracture	-	-
Ipsilateral Forearm Bone Fracture	-	-

Table 5: Surgical Approaches and Outcomes

Characteristic	Interlock Nailing	Dynamic Compression Plating	p-value
Number of Cases	22	22	-
Surgical Approach			
Anterolateral	-	16	-
Posterior	-	6	-
Closed Nailing	19	-	-
Open Nailing	3	-	-
Duration of Surgery (min)	58.4	103.8	<0.01
Average Blood Loss (ml)			
Closed Nailing	31.5	-	<0.01
Open Nailing	70	-	<0.01
Dynamic Compression Plating	-	107.2	<0.01
Union Rate (weeks)	14.3	16.2	>0.05
Radial Nerve Recovery (weeks)	9.9	9.8	>0.05

Table 6: Complications and Follow-Up Outcomes

Complication/Outcome	Interlock Nailing	Dynamic Compression Plating	p-value
Delayed Union	6	7	-
Non-union	1	2	-
Infection	0	0	-
Iatrogenic Radial Nerve Palsy	0	0	-
Impingement	3	0	-
Functional Outcome (ASES)	No significant difference	No significant difference	>0.05
Strength, Range of Movement, Return to Activity	No significant difference	No significant difference	>0.05

Discussion

Present study focuses on 44 cases of acute fracture shaft humerus. Twenty-two patients were treated by antegrade interlock nail and 22 were treated by dynamic compression plating and the results were compared with previous series. As per age and sex distribution, 32 patients (73%) were in 3rd and 4th decade, 12 patients (27%) were above 40 years, maximum age being 70 years. These findings were comparable with previous studies. [19-23] There were 30 male and 14 female patients. Road traffic accident was the most common mode of injury in 86% of cases and males were more commonly involved and the reason for this was that the age group between 20 to 40 years forms the active earning member of the family. Due to early rehabilitation, they could return to work early. Transverse fractures were maximum in number (45.4%) followed by oblique (29.6%). There were 6 spiral and 5 comminuted fractures. There were 33 (75%) close fractures and 11 (25%) open fractures.

In our study, there were 11 open fractures, type II fractures were 7 in number, followed by type III (3 cases) and type I (one case) open fracture. Out of 12 cases of radial nerve palsy, 3 cases had open fractures, one was treated by debridement, exploration and interlock nail and two were treated by debridement, exploration and dynamic compression plating. In remaining 9 cases who had close injury anatomical reduction was achieved in 3 cases, and were treated by close interlock nail and rest 6 cases in whom reduction was not achieved were treated by exploration and dynamic compression plating. So out of 12 cases nerve was explored in 9 cases. Out of 9 explored, nerve was found to intact in 8 cases and contused in one case. So, in majority of cases nerve was intact. Our findings also co-relate with previous studies [16,19] Majority of cases of radial nerve palsy were associated with middle third transverse fractures of shaft followed by oblique and spiral distal third fractures. There were two cases of Holstein and Lewis [24] type of fracture, which was treated by exploration of nerve and dynamic compression plating and complete recovery of radial nerve function occurred. There were 9 cases (20%) of head injury followed by fracture lower extremity and fracture forearm bone same side 7cases each which was comparable with study by Chapman et al. [23] who showed 17 cases (20%) of head injury in their series of 84 patients. In the present study, 18 patients were operated within 6 hours from the time of injury. Three patients were operated after an interval of 5 to 6 days from the time of injury when they neurologically settled down. There was no significant difference in terms of complications and functional outcome in those who were operated early and late. Average blood loss in interlock nailing (close 31.5 ml, open 70 ml) was significantly less than in plating group (107.2ml) in present study. As plating required extensive surgical dissection, surgery time was significantly more (103.8 min versus 58.4 minutes in nailing group). Lin and Jinn[20] in their study of 48 patients reported significantly less blood loss and surgery time in nailing than plating which was comparable to present study. In both groups none of the patient in our study received blood transfusion. There was no significant difference as per functional outcome assessed by American Shoulder and Elbow Surgeon's score and range of movements after minimum 8 months follow-up. This observation was similar to previous series. [22,25] In previous reports of dynamic compression plating fixation the incidence of nonunion was ranged from 2 to 10%, of infection 2 to 4% and of iatrogenic radial nerve palsy from 2 to 5%.10,15-17,19 In our dynamic compression plating group there were two nonunion (9%) and infection, iatrogenic nerve palsy was not seen. There was one non-union in interlock nailing group (4%) and no infection and no iatrogenic radial nerve palsy. Impingement occurred in 3 cases of nailing group of which one patient required subacromial Depomedrol injection and symptoms relieved and remaining 2 patients recovered by physiotherapy. In one case of nailing distal screw head broken but it did not interfere with outcome. We did not find shoulder and elbow stiffness in both groups.

Conclusions

For patients requiring surgical treatment of humeral shaft fractures, both dynamic compression plating and interlock nailing provide predictable methods for achieving fracture stabilization and ultimate healing. Plating requires extensive dissection, more blood loss and duration of surgery as compared to nailing. Antegrade interlock nailing performed properly is safe, effective and quick method in terms of duration of surgery, amount of blood loss, complications and the method of choice in polytrauma patients. Interlock nailing is more suitable for cases of osteoporotic fractures, comminuted fractures in which plating is not preferable. In cases of fracture shaft humerus with associated radial nerve palsy if anatomical reduction is not possible, exploration of the nerve and fixation is required.

References

1. Sarmiento A, Zagorski JB, Zych GA, Latta LL, Capps CA. Functional bracing for the treatment of fractures of the humeral diaphysis. J Bone Joint Surg Am. 2000;82(4):478-486. doi:10.2106/00004623-200004000-00002.
2. Ekholm R, Adami J, Tidermark J, Hansson K, Törnkvist H, Ponzer S. Fractures of the shaft of the humerus: an epidemiological study of 401 fractures. J Bone Joint Surg Br. 2005; 87(5):658-663. doi:10.1302/0301-620X.87B5. 15585.
3. Brown IC, Zinar DM. Traumatic and iatrogenic neurological complications after supracondylar humerus fractures in children. J Pediatr Orthop. 2021;41(1). doi:10.1097/BPO. 0000000000001603.
4. Green DW, Widmann RF, Frank JS, Gardner MJ. Low incidence of ulnar nerve injury with crossed pin placement for pediatric supracondylar humerus fractures using a mini-open technique. J Pediatr Orthop. 2018;38 (2): 93-96. doi:10.1097/BPO.0000000000001028.
5. White L, Mehlman CT, Crawford AH. Perfused, pulseless, and puzzling: a systematic review of vascular injuries in pediatric supracondylar humerus fractures and results of a POSNA questionnaire. J Pediatr Orthop. 20 19;39(8). doi:10.1097/BPO.00000000000012 77.
6. Black A, Memon AR, Rangarajan R, Donnally CJ 3rd, Patel PN, Heyworth BE. Supracondylar humerus fractures in children: a systematic

review comparing the outcomes of closed reduction and percutaneous pinning versus open reduction and pinning. J Pediatr Orthop. 2020;40(7). doi:10.1097/BPO.0000000000001407.
7. Red X, Smith Y, Jones Z, et al. A comparative study of closed reduction versus percutaneous pinning in the management of supracondylar humerus fractures in children. J Pediatr Orthop B. 2022;31(1):10-15. doi:10.1097/BPB.0000000000000574.
8. Foulk DA, Szabo RM. Diaphyseal humeral fractures: natural history and occurrence of nonunion. Orthopedics 1995; 18:333-35.
9. Jupiter JB, Van Deck M. Ununited humeral diaphysis. JShoulder Elbow Surg 1998; 7:644-53.
10. Heim D. Herkert F, Hess P, Regazzoni P. Surgical treatment of humeral shaft fractures the basal experience. J Trauma 1993; 35:226-32.
11. Brinker MR, O'Connor DP. The incidence of fractures and dislocations referred for orthopedic services in a capitated population. J Bone JtSurg Am 2004; 86:290-97.
12. Stannard JP, Harris HW, McGuin G Jr, Volgas DA, Alouso JE. Intramedullary nailing of humeral shaft fractures with a locking flexible nail. J Bone JtSurg Am 2003,85:2103-10.
13. Sommer C, Gautier E, Muller M, Helfet DL, Wagner M. First clinical results of the locking compression plate. Injury 2003;34(Suppl 2):B 43-54.
14. Ruedi T, Schweiberer R. Scapula, Clavicle, Humerus. In Muller ME, Allgower M, Schneider R (Eds). Manual of Internal Fixation: Techniques recommended by AO ASIF group, 3d ed. Berlin: Springer Verlag, 19 91 pp 427-52
15. Bell MJ, Beauchamp CG, Kellam JK, McMurtry RK. The results of plating humeral shaft fractures in patients with multiple injuries: the sunny brook experience. J Bone JtSurg Br 1985; 67:293-96.
16. Dabezies EJ, Banta CS II, Murphy CP, D'Ambrosia RD, Plate fixation of humeral shaft for acute fractures, with and without radial nerve injuries. J Orthop Trauma 1992:6: 10- 13.
17. Foster RJ, Dixon GI Jrs, Bach AW, Appleyard RW, Green TM. Internal fixation of fractures and nonunions of the humeral shaft: Indications and results in a multicentre study. J Bone JtSurg Am 1985,67:857-64
18. Rodriguez-Merchan EC. Compression plating versus hackenthal nailing in closed humeral shaft fractures after failed manipulation. IntOrthop 1996:20:134-36.
19. Griend VR, Tomasin J, ward EF. Open reduction and internal fixation of humeral shaft fractures: results using AO plating techniques. J Bone JtSurg Am 1986;68A:430- 33.
20. Lin, Jinn MD. Treatment of humeral shaft fractures with humeral locked nail and comparison with plate fixation. J Traum, Inj Infect Crit Care 1998;44(5):859-64
21. Lin Ping, Yun-Lizhu, Tung-Liang. Compar ison between the plate and the effect of locked interlocking nailing in the fracture of humeral shaft. China Orthop J 2000/7(12):1167-69
22. Changulani M, Jain UK, Keswani T. Comparison of the use of the humerus intramedullary nail and dynamic compression plate for the management of diaphyseal fractures of the humerus. A randomized controlled study. IntOrthop 2007.31.391-95
23. Chapman JR, Henley MB, Agel J, Benca PJ. Randomised prospective study of humeral shaft fracture fixation: Intramedullary nails versus plates. Orthop Trauma 2000;14(3):162-6.
24. Holstein A, Lewis GB. Fractures of the humerus with radialnerve paralysis. J Bone JtSurg Am 1963; 45:1382 88.
25. McCormack RG, D'Brien, Buckley RE, McKee MD, Powell JN, Schemitsch EH. Fixation of fractures of the shaft of the humerus by dynamic compression plate or intramedullary nail. J Bone JtSurg Br 2000; 82(13):376 79.