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A PROSPECTIVE, COMPARATIVE STUDY IN MANAGEMENT OF FRACTURE SHAFT HUMERUS WITH DYNAMIC COMPRESSION PLATING VERSUS INTRAMEDULLARY NAILING

Orthopaedics

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ABSTRACT

The management of humeral shaft fractures (HSFs) has evolved from conservative techniques to more sophisticated surgical methods, with dynamic compression plating (DCP) and intramedullary nailing (IMN) being two prevalent surgical options. This study prospectively compares the clinical and radiological outcomes of DCP and IMN in the treatment of acute HSFs. A total of 60 patients were included, divided into two groups: 30 patients underwent IMN and 30 patients received DCP. Over a follow-up period averaging one year, outcomes such as fracture union time, functional recovery, pain levels, and complications were assessed. Results showed that both methods achieved satisfactory outcomes, but DCP was associated with fewer complications related to shoulder impingement. While IMN resulted in a marginally quicker radiological union, this difference was statistically insignificant ($p = 0.086$). The incidence of shoulder impingement was 20% in the IMN group compared to none in the DCP group ($p = 0.024$). Delayed union occurred in 13.3% of the DCP group versus 10% in the IMN group, but this difference was not statistically significant ($p > 0.05$). Overall, while both methods are effective, DCP demonstrated slightly better long-term outcomes in terms of functional recovery and fewer complications.

KEYWORDS

INTRODUCTION

Humeral shaft fractures (HSFs) are significant injuries that disrupt the functional and structural integrity of the upper limb. The humerus, extending from the shoulder to the elbow, plays a vital role in upper extremity movement and load-bearing. Fractures in this region, which account for approximately 3% of all fractures, are typically managed through various conservative and surgical techniques (1, 2). The traditional conservative treatment involves functional bracing, which has evolved over time due to its limitations, including non-union and prolonged immobilization risks (4). Consequently, surgical interventions such as dynamic compression plating (DCP) and intramedullary nailing (IMN) have become prominent choices due to their potential for more effective fracture stabilization and quicker recovery times (5, 6).

Dynamic compression plating (DCP) involves the use of a metal plate affixed to the outer surface of the humeral shaft, which compresses the fracture fragments together to promote healing. Conversely, intramedullary nailing (IMN) uses a rod inserted into the medullary canal of the humerus, stabilizing the fracture from within. Both techniques have specific indications, advantages, and limitations (7, 8, 9).

Dynamic Compression Plating (DCP):

Introduced by AO/ASIF in the 1980s, DCP provides rigid fixation through a plate that stabilizes the fracture site while allowing early mobilization of the shoulder and elbow joints (10). It involves a surgical incision to directly access the fracture, which can expose the radial nerve to potential injury and may require more extensive soft tissue dissection (11).

Intramedullary Nailing (IMN):

Developed as a less invasive method for fracture fixation, IMN involves inserting a nail through the medullary canal to stabilize the fracture (12). This technique is associated with minimal soft tissue disruption and facilitates early weight-bearing and rehabilitation (13). However, IMN may be complicated by issues such as shoulder impingement, malunion, or irritation of the rotator cuff (14).

This study aims to provide a comparative analysis of DCP and IMN in managing humeral shaft fractures by evaluating various clinical and radiological outcomes, which will help in determining the more effective approach for such injuries.

MATERIALS AND METHODS

Study Design

A prospective, comparative study was conducted to assess the outcomes of DCP versus IMN in the management of humeral shaft fractures. The study was approved by the Scientific Research Committee and the Ethics Committee of K D Medical College, Mathura. Informed consent was obtained from all participants.

Study Population

Patients presenting with humeral shaft fractures at K D Medical College between December 2022 and April 2024 were included in this study. The inclusion and exclusion criteria ensured that only suitable candidates were selected for the study.

Inclusion Criteria

Age: 18 to 60 years, to ensure the study encompasses adults who are expected to benefit from these surgical interventions.

Fracture Type: Closed or Gustilo-Anderson grade 1 open fractures, which are suitable for surgical intervention.

Displacement: Displaced humeral shaft fractures requiring operative management.

Consent: Willingness to provide informed consent for participation in the study.

Medical Fitness: Patients must be medically fit for surgery as assessed by preoperative evaluations.

Exclusion Criteria

Fracture Severity: Gustilo-Anderson grade 2 or 3 open fractures, as these types of fractures often require different management approaches.

Fracture Type: Undisplaced fractures, which are usually managed conservatively.

Surgical Consent: Unwillingness to undergo surgical intervention.

Complications: Presence of neurovascular injuries or pathological fractures.

Comorbidities: Concurrent fractures or significant medical conditions that contraindicate surgical procedures.

Surgical Techniques

Intramedullary Nailing (IMN):
Positioning: Patients were placed in a supine position with the affected arm positioned on a hand table or elevated using a support.

Incision And Approach: A 2 cm incision was made at the lateral aspect of the humerus, from the acromion to the radial tuberosity. A guide wire was inserted into the distal fragment, and a reamer was used to prepare the medullary canal.

Nail Insertion: A suitable intramedullary nail was inserted over the guide wire, and locking screws were placed for stabilization. C-arm fluoroscopy was used to ensure proper alignment.

Postoperative Care: A sling was used for immobilization, and patients were advised to perform passive range-of-motion exercises.

Dynamic Compression Plating (DCP):
Positioning: Patients were placed in the lateral position, with the affected arm in a comfortable position for access to the humerus.

Incision And Approach: A longitudinal incision was made along the lateral aspect of the humerus. The triceps muscle was retracted, and the radial nerve was identified and protected.

Plate Application: A 4.5 mm DCP was applied to the lateral aspect of the humerus. Screws were inserted into both fracture fragments for stabilization.

Postoperative Care: A sling was used for support, and patients began passive and active range-of-motion exercises as tolerated.

Outcome Measures
Radiological Evaluation:
Fracture Healing: Radiological assessments were performed at regular intervals to evaluate fracture healing, defined as the presence of bridging callus across at least three cortices or the disappearance of the fracture line.

Complications: Observed complications included non-union, delayed union, malunion, and shoulder impingement.

Functional Assessment:
DASH Score: The Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire was used to assess functional outcomes related to upper extremity disability.

VAS Score: The Visual Analog Scale (VAS) was used for pain assessment, where patients rated their pain from 0 (no pain) to 10 (worst pain imaginable).

OBSERVATIONS AND RESULTS

Patient Demographics

Table-1: Distribution Of Complications Between The Groups

Complication	Nailing (n=30)		Plating (n=30)		p value
	Frequency	%	Frequency	%	
Delayed Union	3	10.0%	4	13.3%	1.000
Infection	1	3.3%	2	6.7%	1.000
NONUNION	2	6.7%	1	3.3%	1.000
Radial Nerve Injury	0	0.0%	2	6.7%	0.492
Shoulder Impingment	6	20.0%	0	0.0%	0.024

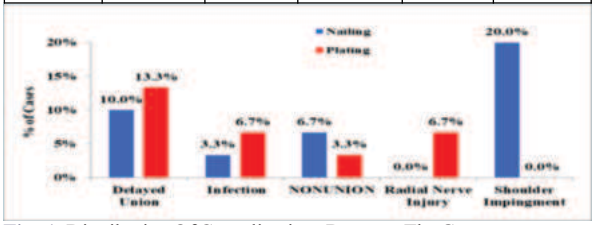

Fig.-1: Distribution Of Complications Between The Groups

Table-1 & Fig.1 show the Comparison of Complications between the groups. Shoulder impingement was the most common complication in nailing (20%) as compared to plating (0%) which is statistically significant with p value 0.024. Delayed union was found as the second most common complication among plating (13.3%) as compared to nailing (10%) group which was insignificantly (p>0.05) higher statistically.

Table-2: Distribution Of Radiological Union Of Fracture In Weeks Between The Groups

	Nailing			Plating			p value
	Mean ± SD	Min - Max	Median (IQR)	Mean ± SD	Min - Max	Median (IQR)	
Radiological union in weeks	n=28; 2 Non union			n=29; 1 Non union			
	16.18 ± 5.79	12 - 34	14.5 (13 - 16)	16.24 ± 3.78	12 – 30	16.0 (14 - 16.50)	0.086

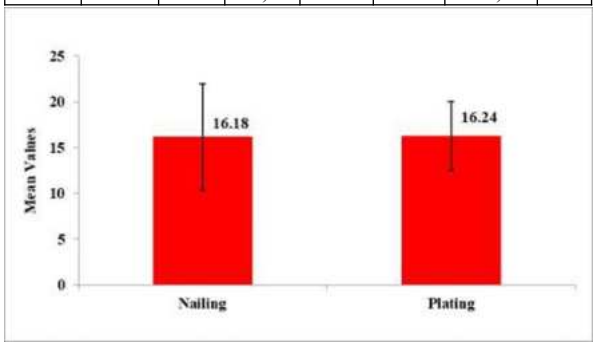

Fig. 2: Distribution Of Radiological Union Of Fracture In Weeks Between The Groups

Table-9 & Fig.9 show the Comparison of radiological Union of fracture between the groups. There was slightly earlier union in nailing group than plating group with statistically no significant difference (p value-0.086).

Table-3: Distribution Of VAS Score At 3 Months Or At Callus

	Nailing			Plating			p value
	Mean ± SD	Min - Max	Median (IQR)	Mean ± SD	Min - Max	Median (IQR)	
VAS AT 3 MONTH or at callus	2.00 ± 1.64	0 - 6	2 (1 - 3)	1.83 ± 1.62	0 – 6	1 (1 - 2.25)	0.605

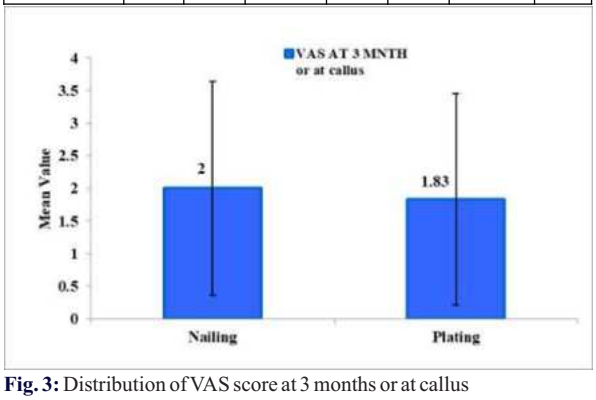

Fig. 3: Distribution of VAS score at 3 months or at callus

Table-10 & Fig.10 show the Comparison of VAS score at 3 months and or at callus formation in both groups. VAS score was insignificant(p>0.05) between the two groups.

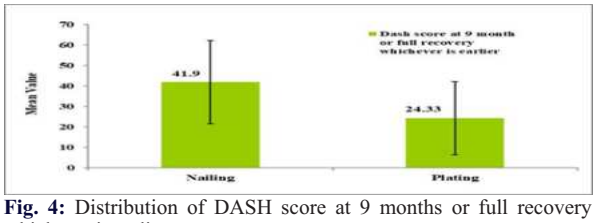

Fig. 4: Distribution of DASH score at 9 months or full recovery whichever is earlier

Table-4: Distribution Of DASH Score At 9 Months Or Full Recovery Whichever Is Earlier

	Nailing			Plating			p value
	Mean ± SD	Min - Max	Median (IQR)	Mean ± SD	Min - Max	Median (IQR)	
Dash score at 9 month or full recovery which ever is earlier	41.90 ± 20.32	14 - 80	38 (24 - 58.50	24.33 ± 17.89	5 - 67	25 (6 - 34.50)	0.001

Table-11 & Fig.11 show the Comparison of DASH score at 9 months or full recovery whichever was earlier. In both groups Mean DASH score was significantly ($p<0.05$) lower in patients of Plating group than in nailing group at 9 month or full recovery.

Pre-operative **Post-operative**

Pre-operative **Post-operative**

DISCUSSION

The management of humeral shaft fractures has evolved significantly over the years. This study provides a comprehensive evaluation of two common surgical techniques—dynamic compression plating (DCP) and intramedullary nailing (IMN)—for the treatment of these fractures.

Comparison of Techniques

Dynamic Compression Plating (DCP):

DCP has long been a standard method for fracture stabilization due to its ability to provide rigid fixation and direct access to the fracture site for precise alignment and fixation (15). The method allows for a stable environment conducive to bone healing and facilitates early range-of-motion exercises. However, it is associated with potential complications such as infection, radial nerve injury, and the need for larger surgical incisions (16, 17).

Intramedullary Nailing (IMN):

IMN, a relatively newer technique, offers advantages such as less invasive procedures, minimal soft tissue disruption, and the ability to stabilize fractures through the medullary canal (18). It allows for early mobilization and weight-bearing. However, complications such as shoulder impingement, malunion, and irritation of the rotator cuff can occur (19, 20). Our study found that shoulder impingement was significantly higher in the IMN group, which aligns with findings from other studies that report this complication as a notable downside of the technique (21).

Functional and Radiological Outcomes

Our study found that the time to radiological union was slightly shorter for the IMN group compared to the DCP group, but this difference was not statistically significant ($p = 0.086$). This finding supports the idea that while IMN may offer faster initial fracture healing, both techniques ultimately achieve similar radiological outcomes. The slight difference observed could be attributed to the inherent biological healing processes and not necessarily to the superiority of one technique over the other.

In terms of functional outcomes, as measured by the DASH score, there was no significant difference between the two techniques, suggesting that both IMN and DCP provide comparable functional recovery for patients with humeral shaft fractures. However, the VAS scores for pain were also similar across both groups, indicating that neither method significantly affects postoperative pain levels differently.

Clinical Implications

This study supports the use of both IMN and DCP as effective methods for managing humeral shaft fractures. While both techniques offer satisfactory outcomes, DCP demonstrated fewer complications related to shoulder impingement, which is a significant consideration for long-term functional outcomes. The decision between IMN and DCP should be guided by patient-specific factors, including the fracture pattern, comorbidities, and the potential risks of each technique.

CONCLUSION

In summary, both dynamic compression plating (DCP) and intramedullary nailing (IMN) are viable surgical options for the management of humeral shaft fractures. Our study demonstrates that while IMN may lead to a slightly quicker radiological union, DCP offers advantages in terms of fewer complications, particularly related to shoulder impingement. The functional outcomes, as measured by the DASH score, and pain levels, as measured by the VAS score, did not show significant differences between the two techniques. The choice of surgical technique should be based on individual patient factors and surgeon preference, with consideration of the potential risks and benefits associated with each method.

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