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Research Article

Outcomes of Closed Diaphyseal Humeral Fractures Treated by Dynamic Compression Plate versus Intramedullary Nail

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ABSTRACT

Background: Compression plates and intramedullary nails are commonly used devices for stabilizing humeral shaft fractures. Nailing is often associated with postoperative shoulder pain and stiffness due to impingement from prominent implants. Plate fixation may reduce the risk of shoulder problems and the likelihood of reoperation.

Objective: This study aims to compare the outcomes of closed diaphyseal humeral fractures treated with dynamic compression plates versus intramedullary nails.

Methods: A total of 40 patients with closed diaphyseal humeral shaft fractures, reported within two weeks of injury, were included in the study. Clinical examinations and X-rays were utilized for diagnosis. Patients were divided into two groups: Group A received dynamic compression plates, while Group B received intramedullary nails. Postoperative assessments included severity of pain, complications, and hospital stay. The Chi-square test was applied, with a p-value of <0.05 considered significant.

Results: Postoperatively, in the dynamic compression plate group, 50% experienced mild pain, 35% moderate pain, and 15% severe pain. In the intramedullary nail group, 30% had mild pain, 50% moderate pain, and 20% severe pain. Complications were observed in 4 patients in Group A and 7 in Group B. Hospital stays ranged from 1-10 days for 40% of Group A patients and 11-20 days for 60%. For Group B, 55% stayed 1-10 days and 45% stayed 11-20 days.

Conclusion: The management of closed diaphyseal humeral fractures with dynamic compression plates is superior to intramedullary nails, exhibiting lower rates of pain severity and complications.

Keywords: Diaphyseal Humeral Fractures, Dynamic Compression Plate, Intramedullary Nail, Outcomes.

INTRODUCTION

Fractures of the humeral shaft are frequently encountered in orthopedic clinics, comprising approximately 1.31% to 3% of all fractures. These fractures can be categorized based on the site of injury into proximal, shaft, and distal humeral fractures. Humeral shaft fractures account for roughly 3% of all fractures in adults. Treatment approaches continue to evolve with advancements in both non-operative and operative management. The humeral shaft is well-vascularized and covered by muscles, allowing for slight malunion without significant functional impairment. While most humeral shaft fractures are effectively treated non-operatively, certain cases may necessitate primary or secondary surgical intervention.

Non-operative treatment may involve casts or functional braces, while surgical fixation can be achieved through plating, nailing, or external fixation. External fixation is typically reserved for temporary stabilization of open fractures or in polytrauma cases. Plating and intramedullary nailing are the primary surgical options for closed humeral shaft fractures. Surgical stabilization is particularly beneficial for bilateral fractures of the humerus and ipsilateral humeral and forearm fractures.

McCormack et al. conducted a prospective randomized study concluding that open reduction and internal fixation with a dynamic compression plate (DCP) remains the best treatment for unstable humeral shaft fractures. Intramedullary nailing is technically more demanding and associated with a higher complication rate. Other studies have reported comparable results, indicating that plating is often superior to nailing. In 2010, a prospective comparative study revealed that the plating group exhibited a higher rate of excellent outcomes and earlier union compared to the nailing group. Rommens et al. noted that 90% of patients achieved excellent function in the shoulder and elbow with both fixation methods, with only 5% requiring secondary surgery. Dabezies et al. reported a 97% union rate with modern plate and screw fixation techniques. However, some studies suggest that intramedullary nails may offer shorter union times and lower incidences of severe complications, although no significant differences were found between the two groups regarding union rates and functional outcomes.

MATERIALS AND METHODS

Study Duration

This comparative study was conducted from January 2024 to December 2024.

Study Setting

Bolan Medical Complex Hospital, Quetta Pakistan

Sample Size

A total of 40 participants of both genders, aged 20 to 40 years.

Data Collection Procedure

Patients were admitted to the Orthopedic Unit through the outpatient or casualty departments with diagnosed closed diaphyseal humeral shaft fractures (types A1-2, A2-2, and A3-2) associated with minor head injuries, all within two weeks of injury. Exclusion criteria included open fractures, severe chest or abdominal injuries, pathological fractures, and malunited fractures with neurological deficits. Institutional research and ethical committee approval was obtained, and written informed consent was secured from all participants. All patients underwent a complete physical examination, including recording temperature, pulse, respiration, and blood pressure. Fracture types were diagnosed based on clinical examination and X-rays. A systemic review was conducted to assess any major or minor head injuries. The selected patients were randomly allocated into two groups: 20 patients received dynamic compression plates (Group A), and 20 patients received intramedullary nails (Group B).

Data Analysis Method

Descriptive statistics were calculated. Qualitative variables such as gender, age groups, radiographic findings, severity of pain, and mode of injury, complications, and hospital stay were presented in terms of frequency and percentage. The Chi-square test was applied to compare proportions between the two groups. Quantitative variables like age and hospital stay were presented as mean ± standard deviation, and the Student's t-test was applied to compare means. A p-value of <0.05 was considered significant for all analyses, using SPSS version 20.

RESULTS

Among the 40 patients, 35 (87.5%) were males and 5 (12.5%) were females, with an overall mean age of 29.78 ± 4.91 years. The mean age for the dynamic compression plate group was 30.00 ± 4.91 years, while for the intramedullary nail group, it was 29.55 ± 5.03 years. The majority of patients (72.5%) were aged between 21-30 years

Table 1: Descriptive Statistics of Age and Gender

Age (years)	Overall	Dynamic Compression Plate	Intramedullary Nail
Mean ± SD	29.78 ± 4.91	30.00 ± 4.91	29.55 ± 5.03
Range	18	17	18
Minimum	22	22	22

Maximum	40	39	40
21-30 years	29 (72.5%)	14 (70%)	15 (75%)
31-40 years	11 (27.5%)	6 (30%)	5 (25%)

Table 2: Frequency Distribution of Mode of Injury, Radiological Findings, and Severity of Pain

	Overall	**Dynamic Compression Plate**	**Intramedullary Nail**
Mode of Injury			
Fall	8 (20%)	3 (15%)	5 (25%)
Road Traffic Accident	23 (57.5%)	12 (60%)	11 (55%)
Assault	9 (22.5%)	5 (25%)	4 (20%)
Radiographic Findings			
Oblique	22 (55%)	10 (50%)	12 (60%)
Transverse	12 (30%)	7 (35%)	5 (25%)
Spiral	6 (15%)	3 (15%)	3 (15%)
Severity of Pain			
Mild	16 (40%)	10 (50%)	6 (30%)
Moderate	17 (42.5%)	7 (35%)	10 (50%)
Severe	7 (17.5%)	3 (15%)	4 (20%)

Postoperative Complications and Hospital Stay

In the dynamic compression plate group, 4 complications were observed, while 7 complications occurred in the intramedullary nail group. The difference was not statistically significant (p=0.288). The overall hospital stay averaged 14.30 ± 4.83 days, with 47.5% of patients staying ≤10 days and 52.5% staying 11-20 days.

Table 3: Comparison of Postoperative Complications

	Dynamic Compression Plate	**Intramedullary Nail**	**Total**	**P-Value**
Infection	Yes: 4 (20%)	Yes: 7 (35%)	11 (27.5%)	0.288*
	No: 16 (80%)	No: 13 (65%)	29 (72.5%)	

Overview of Injury Mechanisms and Radiographical Findings

The study identified the modes of injury for a total of 40 patients: 8 patients had a history of falls, 23 patients were involved in road traffic accidents, and 9 patients experienced assaults. Within the Dynamic Compression Plate (DCP) group, 3 patients had a history of falls, 12 had road traffic accidents, and 5 had assaults. In the Intramedullary Nail (ILN) group, 5 patients reported falls, 11 had road traffic accidents, and 4 had assaults.

Radiographical Findings

Regarding radiographical outcomes, oblique fractures were observed in 22 patients, transverse fractures in 12 patients, and spiral fractures in 6 patients. Specifically, in the DCP group, oblique fractures were noted in 10 patients, transverse in 7 patients, and spiral in 3 patients. In the ILN group, oblique fractures were present in 12 patients, transverse in 5 patients, and spiral in 3 patients.

Pain Severity Assessment

Pain severity was assessed in both groups, revealing that 16 patients experienced mild pain, 17 reported moderate pain, and 7 had severe pain. In the DCP group, mild pain was noted in 10 patients, moderate pain in 7 patients, and severe pain in 3 patients. The ILN group showed mild pain in 6 patients, moderate pain in 10 patients, and severe pain in 4 patients (See Table 2).

Postoperative Complications and Hospital Stay

Table 4: Comparison of Postoperative Individual Complications

Complications	**Dynamic Compression Plate**	**Intramedullary Nail**	**Total**	**P-Value**
Infection	Yes: 1 (5%)	No: 0 (0%)	1 (2.5%)	1.000**
	No: 19 (95%)	20 (100%)	39 (97.5%)	

Iatrogenic Palsy	Yes: 1 (5%)	No: 0 (0%)	1 (2.5%)	1.000**
	No: 19 (95%)	20 (100%)	39 (97.5%)	
Non Union	Yes: 1 (5%)	Yes: 1 (5%)	2 (5.0%)	1.000**
	No: 19 (95%)	19 (95%)	38 (95.0%)	
Severe Impingement	Yes: 0 (0%)	Yes: 3 (15%)	3 (7.5%)	0.231**
	No: 20 (100%)	17 (85%)	37 (92.5%)	
Adhesive Capsulitis	Yes: 0 (0%)	Yes: 2 (10%)	2 (5.0%)	0.487**
	No: 20 (100%)	18 (90%)	38 (95.0%)	
Minimal Loss of Fixation	Yes: 1 (5%)	No: 0 (0%)	1 (2.5%)	1.000**
	No: 19 (95%)	20 (100%)	39 (97.5%)	
Late Fracture	Yes: 0 (0%)	Yes: 1 (5%)	1 (2.5%)	1.000**
	No: 20 (100%)	19 (95%)	39 (97.5%)	

Chi-square test applied; p-value < 0.05 considered significant. ** Not significant at the 0.05 level.

In total, 4 complications were observed in the DCP group, while 7 complications were noted in the ILN group (See Graph 1). However, this difference was not statistically significant (p=0.288) (See Table 3). In the DCP group, 80% of patients experienced no complications, while among the 4 patients with complications, there were instances of 5% infection, 5% iatrogenic radial nerve palsy, 5% non-union, and 5% minimal loss of fixation. In the ILN group, 65% had no complications, with 7 complications reported, including 5% non-union, 15% severe impingement, 10% adhesive capsulitis (shoulder), and 5% late fracture (See Graph 2).

Hospital Stay Evaluation

The postoperative hospital stay was evaluated, revealing an overall average of 14.30±4.83 days, with a range of 8 to 20 days. Among the patients, 19 (47.5%) stayed for 10 days or less, while 21 (52.5%) stayed between 11 to 20 days. In the DCP group, the mean stay was 15.05±5.03 days, with 8 (40%) patients staying for 10 days or less and 12 (60%) for 11 to 20 days.

Table 5: Descriptive Statistics and Comparison of Hospital Stay

Overall	Dynamic Compression Plate	Intramedullary Nail
Hospital Stay (days)	Mean±SD: 14.30±4.83	15.05±5.03
Range	12	12
Minimum	8	8
Maximum	20	20
P-value	0.333**	
1-10 days	19 (47.5%)	8 (40%)
11-20 days	21 (52.5%)	12 (60%)
P-value	0.342**	

Chi-square test applied; p-value < 0.05 considered significant. ** Not significant at the 0.05 level.

DISCUSSION

The variety of fracture patterns and situations complicates the comparison of clinical studies regarding the fixation methods for these fractures, often leading to treatment decisions based on personal experience, which introduces subjective bias. This study aimed to compare functional outcomes between dynamic compression plates and intramedullary nails for humeral shaft fractures.

In this study, 85% of patients in the DCP group were male, while 90% in the ILN group were male, with only 15% and 10% being

female, respectively. The male-to-female ratio in the DCP group was 5.6:1, compared to 9:1 in the ILN group, likely reflecting lifestyle factors that contribute to higher fracture rates in males, particularly in our region. The age range of patients was between 21 to 40 years, with a mean age of 29.78±4.91 years. The most common mechanism of humeral shaft fractures was road traffic accidents, accounting for 23 (57.5%) cases, followed by assaults (9 cases) and falls (8 cases). Radiological findings indicated that oblique fractures were the most common, followed by transverse and spiral fractures. Patients in the ILN group reported higher levels of postoperative pain compared to the DCP group, with 50% experiencing mild pain in the DCP group versus 30% in the ILN group. In conclusion, our study suggests that humeral shaft fractures are most prevalent among young males, primarily due to road traffic accidents. The use of dynamic compression plates appears to be a more effective method for treating these fractures.

CONCLUSION

The findings of our study indicate that humeral shaft fractures are most prevalent in young males, with road traffic accidents being the primary cause of these injuries. Among these, motorcycle accidents are the most significant contributing factor. Furthermore, the use of dynamic compression plates is shown to be a more effective method for managing these types of fractures.

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