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OUTCOME OF HUMERUS SHAFT FRACTURES IN ADULTS TREATED BY DYNAMIC COMPRESSION PLATE IN MARDAN MEDICAL COMPLEX

Original Research

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ABSTRACT

Background: Humerus shaft fractures constitute approximately 3% of all fractures and are commonly managed through surgical or conservative methods depending on fracture complexity and patient condition. Dynamic compression plating (DCP) is widely regarded as a reliable surgical option, promoting union and functional recovery while minimizing complications. Despite its effectiveness, limited regional data is available to guide clinical decision-making. This study aims to evaluate the functional outcomes of DCP in the treatment of humerus shaft fractures at Mardan Medical Complex.

Objective: To determine the functional outcomes of humerus shaft fractures in adults treated with dynamic compression plating.

Methods: This descriptive case series was conducted at Mardan Medical Complex from June 22, 2021, to December 22, 2021. A total of 139 patients aged 18–70 years, with humerus shaft fractures presenting within 10 days of injury, were included. Patients with upper or lower humerus fractures, segmental fractures, or prior open fractures were excluded. All procedures were performed using DCP, and functional outcomes were assessed using the DASH score on the 30th postoperative day. Data on demographic characteristics, injury mechanisms, and outcomes were analyzed.

Results: The mean age of the 139 patients was 32.86±13.55 years. Of these, 72.7% were male and 58.3% sustained fractures due to road traffic accidents. Functional outcomes revealed excellent results in 20.9% (n=29), good outcomes in 61.9% (n=86), fair outcomes in 15.1% (n=21), and poor outcomes in 2.2% (n=3). Middle third fractures accounted for 59% of cases, followed by distal and proximal fractures at 24.5% and 16.5%, respectively.

Conclusion: Dynamic compression plating is an effective surgical technique for managing humerus shaft fractures, achieving excellent to good outcomes in the majority of cases. The findings support DCP as a preferred treatment option for optimizing functional recovery in these fractures.

Keywords: Dynamic compression plate, Fracture fixation, Humerus, Orthopedic procedures, Outcomes assessment, Postoperative recovery, Trauma management.

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INTRODUCTION

The humerus, a long bone of the upper limb extending from the shoulder to the elbow, is anatomically divided into the shaft (diaphysis) and epiphyses (1, 2). Fractures of the humeral shaft commonly occur due to direct trauma, with traffic accidents and falls being the primary causes. These fractures are particularly prevalent among the elderly, often resulting from fragility-related injuries, and among younger individuals under 30 years of age due to high-energy trauma (3). Accounting for approximately 20% of all humeral fractures and 3-5% of total fractures, humeral shaft fractures represent a significant challenge in orthopedic practice, necessitating effective and evidence-based treatment approaches (4).

Several techniques have been explored and implemented to address humeral shaft fractures, including dynamic compression plates (DCP), minimally invasive plate osteosynthesis (MIPO), intramedullary nailing (IMN), external fixation, and open reduction methods (5). External fixation, a conventional treatment, remains an effective strategy for certain open fractures, achieving a success rate of up to 90% without surgical intervention. However, in cases involving open fractures, pathological fractures, neurovascular injuries, or complex fracture patterns like spiral fractures, DCP has emerged as a superior approach. This method provides a higher rate of fracture union, minimizes complications such as malunion or nonunion, and preserves blood supply and soft tissue integrity, thereby promoting functional recovery (6, 7).

Dynamic compression plating has gained traction as a preferred technique among orthopedic surgeons due to its promising clinical outcomes. Prospective studies have reported an average union time of 8.64±1.96 weeks, particularly in patients aged 20 to 39 years, with excellent or good outcomes observed in the majority of cases. Functional outcomes, as evaluated using the DASH (Disabilities of the Arm, Shoulder, and Hand) score, have consistently demonstrated high levels of patient satisfaction and recovery (8). Despite its efficacy, the adoption of DCP remains less documented in some regions, necessitating further research to validate its utility in diverse patient populations and clinical settings (9, 10).

This study aims to evaluate the effectiveness of the dynamic compression plate in managing humeral shaft fractures, providing valuable insights into its clinical outcomes. By contributing robust local data to the existing body of knowledge, the findings of this study are intended to guide healthcare practitioners in recommending DCP as an optimal intervention for patients, particularly in cases where conservative treatment fails or the fracture's complexity warrants surgical intervention.

METHODS

After obtaining approval from the hospital's ethical committee, patients meeting the inclusion criteria were recruited through the outpatient department. Informed written consent was secured from all participants prior to their inclusion in the study. Comprehensive patient histories were documented, and thorough physical examinations were conducted alongside radiological assessments to confirm the diagnosis and plan the surgical approach.

The anterolateral approach was employed for fractures of the upper and middle thirds of the humeral shaft, while the posterior approach was utilized for fractures in the distal third. Special care was taken during the posterior approach to identify and protect the radial nerve intraoperatively. To achieve optimal fixation, a minimum of three screws were inserted on either side of the fracture site. For spiral and oblique fractures, interfragmentary screws were used to supplement fixation, ensuring adequate stability. All procedures were performed under sterile conditions by an experienced orthopedic surgeon, ensuring adherence to standardized surgical protocols.

Postoperative assessments of functional outcomes were conducted on the 30th postoperative day using the Disabilities of the Arm, Shoulder, and Hand (DASH) criteria. Patient progress, clinical observations, and outcomes were meticulously recorded on a predesigned pro forma for consistency and accuracy. The recorded data included demographic information, injury characteristics, surgical details, and functional recovery metrics.

Data analysis was performed using IBM SPSS version 20. Continuous variables such as age were expressed as means and standard deviations, while categorical variables, including gender, cause of injury, fracture location, and functional outcomes, were presented as frequencies and percentages. Functional outcomes were stratified by age, gender, cause of injury, and fracture location. Post-stratification

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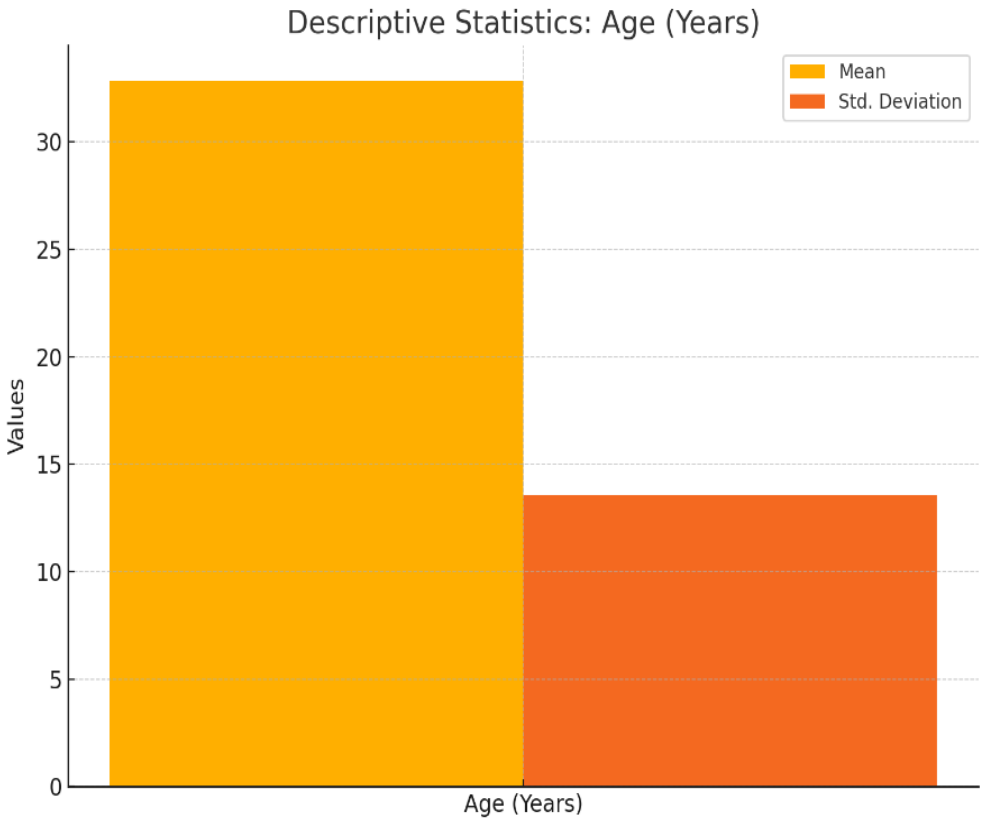
analysis was conducted using the Chi-square test, with a p-value of less than 0.05 considered statistically significant. Results were synthesized into tables and graphs for clear visualization of findings.

RESULTS

The study analyzed data from 139 patients with humeral shaft fractures. The mean age of the patients was 32.86±13.55 years. Among the participants, the majority (61.9%) were aged between 18 and 30 years, followed by 23.7% in the 31 to 50-year age group, and 14.4% aged 51 to 70 years. Gender distribution showed a predominance of male patients, constituting 72.7% of the sample, while females accounted for 27.3%. The primary cause of injury was road traffic accidents, reported in 58.3% of cases, with falls from height contributing to 28.1% and direct trauma to the arm accounting for 13.7%.

The fracture locations varied, with 59% occurring in the middle third of the humeral shaft, 24.5% in the distal third, and 16.5% in the proximal third. Functional outcomes, assessed using the DASH criteria, revealed that 61.9% of patients achieved a good outcome, 20.9% had excellent outcomes, and 15.1% demonstrated fair recovery. Only 2.2% of patients reported poor outcomes, indicating the overall effectiveness of the treatment protocol.

Stratification of functional outcomes showed that younger patients (aged 18 to 30 years) had the highest proportion of good and excellent outcomes. Gender-wise analysis indicated that male patients exhibited slightly better recovery trends compared to females. Furthermore, patients with fractures resulting from road traffic accidents had a higher incidence of excellent outcomes, while fractures located in the middle shaft region showed the most favorable results. These findings underline the significance of age, gender, cause of injury, and fracture location in predicting functional recovery.



The chart illustrates the descriptive statistics for the age of patients, showing a mean age of 32.86 years and a standard deviation of 13.56 years, indicating variability within the studied population.

Figure 1 Descriptive Statistics: Age (Years)

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The chart displays the gender distribution of patients, with males comprising 72.7% and females accounting for 27.3% of the study population.

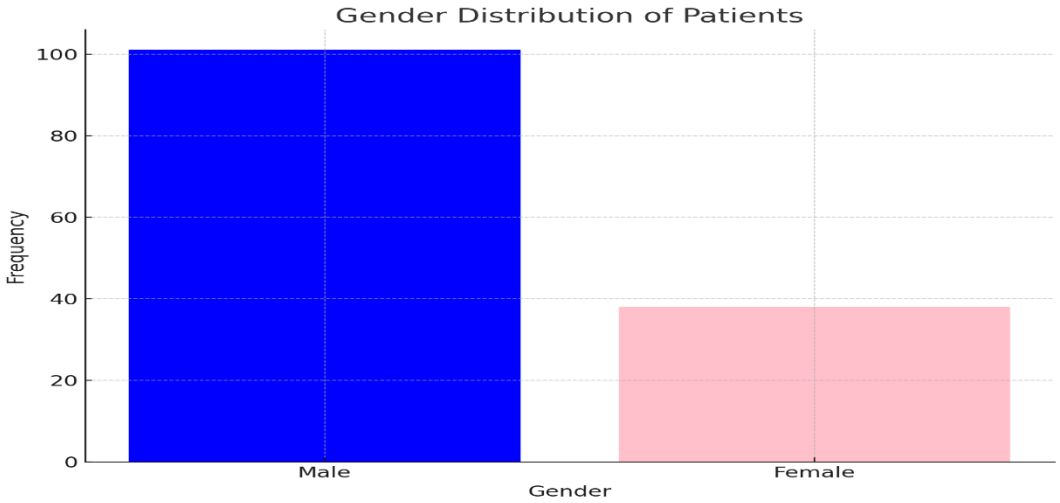

Figure 2 Gender Distribution of Patients

Table 1 Age distribution, Cause of injury, Location of fracture, Functional outcome

Category	Frequency	Percent
Age distribution		
(18 to 30)	86	61.9
(31 to 50)	33	23.7
(51 to 70)	20	14.4
Cause of injury		
(Road traffic accident)	81	58.3
(Fall from height)	39	28.1
(Direct trauma to arm)	19	13.7
Location of fracture		
(Distal)	34	24.5
(Middle)	82	59.0
(Proximal)	23	16.5
Functional outcome		
(Excellent)	29	20.9
(Good)	86	61.9
(Fair)	21	15.1
(Poor)	3	2.2

The study analyzed 139 patients, with 61.9% aged 18 to 30 years, 23.7% aged 31 to 50 years, and 14.4% aged 51 to 70 years. The leading cause of injury was road traffic accidents (58.3%), followed by falls from height (28.1%) and direct trauma to the arm (13.7%). Fracture locations were most common in the middle third of the shaft (59.0%), with 24.5% in the distal third and 16.5% in the proximal third. Functional outcomes revealed 61.9% achieved good results, 20.9% excellent, 15.1% fair, and only 2.2% poor outcomes.

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Table 2 Stratification of functional outcome with age & gender

		Age distribution			Total	P value
		18 to 30	31 to 50	51 to 70		
Functional outcome	Excellent	16	11	2	29	0.12
		55.2%	37.9%	6.9%	100.0%	
	Good	57	14	15	86	
		66.3%	16.3%	17.4%	100.0%	
	Fair	12	6	3	21	
		57.1%	28.6%	14.3%	100.0%	
	Poor	1	2	0	3	
		33.3%	66.7%	0.0%	100.0%	
Total		86	33	20	139	
		61.9%	23.7%	14.4%	100.0%	

		Gender		Total	P value
		Male	Female		0.56
Functional outcome	Excellent	19	10	29	
		65.5%	34.5%	100.0%	
	Good	63	23	86	
		73.3%	26.7%	100.0%	
	Fair	16	5	21	
		76.2%	23.8%	100.0%	
	Poor	3	0	3	
		100.0%	0.0%	100.0%	
Total		101	38	139	
		72.7%	27.3%	100.0%	

The stratification of functional outcomes by age showed that among patients aged 18 to 30 years, 55.2% achieved excellent results and 66.3% achieved good outcomes, with a fair outcome in 57.1% and poor in 33.3%. In the 31 to 50 age group, 37.9% had excellent outcomes and 16.3% achieved good outcomes, while 28.6% had fair results and 66.7% poor. Among those aged 51 to 70 years, 6.9% had excellent outcomes, 17.4% good, 14.3% fair, and none reported poor outcomes. Gender stratification showed that 65.5% of males and 34.5% of females had excellent outcomes, while 73.3% of males and 26.7% of females achieved good results. Fair outcomes were observed in 76.2% of males and 23.8% of females, with poor results exclusively seen in 3% of males.

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Table 3 Stratification of functional outcome with cause of injury & location of fracture

		Cause of injury			**Total**	**P value**
		Road traffic accident	Fall from height	Direct trauma to arm		
Functional outcome	Excellent	17	6	6	29	0.73
		58.6%	20.7%	20.7%	100.0%	
	Good	52	24	10	86	
		60.5%	27.9%	11.6%	100.0%	
	Fair	10	8	3	21	
		47.6%	38.1%	14.3%	100.0%	
	Poor	2	1	0	3	
		66.7%	33.3%	0.0%	100.0%	
Total		81	39	19	139	
		58.3%	28.1%	13.7%	100.0%	

		Location of fracture			Total	P value
		Distal	Middle	Proximal		
Functional outcome	Excellent	6	15	8	29	0.25
		20.7%	51.7%	27.6%	100.0%	
	Good	22	55	9	86	
		25.6%	64.0%	10.5%	100.0%	
	Fair	5	10	6	21	
		23.8%	47.6%	28.6%	100.0%	
	Poor	1	2	0	3	
		33.3%	66.7%	0.0%	100.0%	
		34	82	23	139	
		24.5%	59.0%	16.5%	100.0%	

The stratification of functional outcomes by cause of injury revealed that road traffic accidents accounted for 58.3% of cases, with 58.6% achieving excellent outcomes and 60.5% good outcomes. Falls from height comprised 28.1%, with 20.7% achieving excellent outcomes and 27.9% good outcomes, while 13.7% of cases were due to direct trauma to the arm, yielding 20.7% excellent and 11.6% good outcomes. Poor outcomes were minimal, seen in 2.5% of road traffic accidents and 1.3% of falls. Regarding fracture location, 59.0% were in the middle shaft, resulting in 51.7% excellent outcomes and 64.0% good outcomes. Distal fractures (24.5%) achieved 20.7% excellent outcomes, while proximal fractures (16.5%) had 27.6% excellent results. Poor outcomes were rare and more likely with distal fractures (33.3%).

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DISCUSSION

Fractures of the humeral shaft constitute approximately 3% of all fractures, with a notable prevalence among individuals over 65 years of age, primarily due to osteoporosis and falls. In younger populations, high-velocity trauma from motor vehicle accidents frequently accounts for these injuries. The humeral shaft, extending from the insertion of the pectoralis major to the supracondylar ridge, is anatomically significant, particularly due to the radial nerve's position in the spiral groove (11). This nerve is vulnerable in spiral fractures where it can be entrapped between fragments, emphasizing the importance of its identification, especially in distal extensions (12).

Conservative management with a plaster cast has traditionally been the cornerstone of treatment, promoting callus formation and union. However, prolonged immobility associated with this method is increasingly unacceptable, driving a shift toward operative treatments (13). Open reduction and internal fixation are favored in specific scenarios, including open fractures, vascular or nerve injuries, and cases of multiple injuries or intolerance to functional bracing. Among surgical options, plate fixation with screws is preferred for its ability to provide direct fracture reduction, fragment compression, and radial nerve protection, with a lower risk of complications like shoulder impingement compared to intramedullary nailing. While plate fixation involves extensive dissection, it remains the gold standard for managing humeral shaft fractures, balancing surgical precision and functional recovery (14).

Despite advancements, operative treatment for acute humeral shaft fractures carries a significant complication risk, leaving the ideal treatment strategy open to interpretation. In this study, the majority of patients were male (72.7%), consistent with findings from other studies, such as Singisetti et al (15)., reporting 77% male prevalence . The average age of patients was 32.86±13.55 years, with most cases in the 18–30 age group, aligning with similar observations in the work of Walia et al (). Mechanisms of injury were predominantly road traffic accidents (58.3%) and falls from height (28.1%), paralleling results from studies by Memon et al., where traffic accidents accounted for 63.7% of cases (16).

Functional outcomes in this series demonstrated promising results, with 20.9% achieving excellent outcomes, 61.9% good, 15.1% fair, and only 2.2% poor. These findings are comparable to previous research, further supporting the efficacy of surgical intervention in appropriate cases. Strengths of this study include a well-defined population and comprehensive outcome analysis. However, limitations such as the short follow-up period and lack of long-term functional assessments highlight areas for future research. Overall, the study reinforces the role of dynamic compression plating as a reliable treatment modality for humeral shaft fractures, particularly in complex or non-conservative cases.

A recent comparative study conducted by Dar et al. (2023) evaluated the functional outcomes of dynamic compression plating (DCP) versus intramedullary nailing (IMN) in the management of humeral shaft fractures. This prospective observational study included 60 cases treated surgically at a tertiary hospital. The DCP group demonstrated superior functional outcomes, with 76.7% of cases achieving excellent results compared to 56.7% in the nailing group. Moreover, complications such as shoulder impingement and stiffness were more prevalent in the IMN group. Both techniques, however, were effective in achieving fracture union, with no significant differences in union times. The study concluded that while both methods are viable, DCP offers better functional outcomes and fewer complications, particularly around the shoulder joint. These findings align with the current understanding of DCP as a reliable option for managing humeral shaft fractures requiring surgical intervention (17).

Another comparative study conducted by Azmatullah et al. (2020) assessed the functional outcomes of dynamic compression plating (DCP) versus intramedullary interlocking nailing (IMN) in closed humeral shaft fractures. This prospective study included 82 adult patients randomly divided into two groups. The study found that DCP had significantly better outcomes, with 87.8% of patients in this group achieving acceptable functional results compared to 61% in the IMN group. Functional outcomes were measured using the DASH score, where the DCP group consistently outperformed the IMN group. The authors highlighted that complications such as shoulder impingement and reduced range of motion were more frequent with IMN, supporting the conclusion that DCP provides superior functional recovery in most cases (18).

CONCLUSION

The treatment of humeral shaft fractures in adults using dynamic compression plating demonstrated highly favorable outcomes, with the majority of patients achieving excellent to good functional recovery. This approach proved to be a reliable and effective surgical method, addressing the challenges of fracture management while minimizing complications and promoting early joint mobility and union. The findings underscore the dynamic compression plate as a preferred option for ensuring optimal functional outcomes in suitable clinical scenarios.

AUTHOR CONTRIBUTIONS

Author	Contribution
Tayyab Mustajab Khan	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Inamullah	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Haziq Dad Khan	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published

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