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ORIGINAL ARTICLE

Comparison of outcome of fracture shaft of humerus treated conservatively with a functional brace versus open reduction and internal fixation.

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ABSTRACT… Objective: To determine the frequency of non-union with functional brace versus operative techniques using open reduction and internal fixation in managing mid-shaft humerus fracture. **Study Design:** Randomized Controlled Trial. **Setting:** Department of Orthopedics and Traumatology, Lady Reading Hospital Peshawar. **Period:** 20th July 2023 to 20th January 2024. **Methods:** A total of 156 patients of both genders with mid-shaft humerus fractures were included in the study. Patients in group A were treated surgically. In group B patients were treated non-operatively. At the end of 12 weeks frequency of union/malunion was noted in both groups. **Results:** The age range in this study was from 18 to 60 years with a mean age of 39.666±12.78 years in Group A and a mean age of 42.423±10.66 years in Group B. Male gender was dominant in both groups (76.9% and 71.8%). Nonunion was observed in 2 (2.6%) patients in group A as compared to 15 (19.2%) patients in group B (P= 0.001). **Conclusion:** In conclusion, our study emphasizes that surgical intervention using ORIF is more effective than non-operative management.

Key words: Functional Brace, Mid Shaft Humerus Fracture, Nonunion, Open Reduction and Internal Fixation.

INTRODUCTION

The annual occurrence of humeral shaft fractures is approximately 13 out of every 10,000 patients, constituting 1.0—3.0% of all fractures.[1] The most common age range for humerus fractures is 21 to 30 for males and 60 to 80 for females. However, a humerus fracture can occur in individuals of any age or gender if the right type of injury occurs. The middle third of the humerus is where sixty percent of all humeral fractures occur.[2] The fractures are categorized according to where they are located, whether open or closed and the type of fracture line.[3] A midshaft humerus fracture typically happens because of a direct impact to the upper arm. Trauma, such as falls, motor vehicle accidents, or motorcycle accidents, is the most common cause of fractures. In older individuals, this type of fracture can also result from falling onto an outstretched arm, with the humerus bearing the brunt of the impact instead of the wrist.[4,5]

At the moment, there are no universally accepted best practices for treating humeral shaft fractures.[6] Most humeral shaft fractures are managed conservatively using a functional brace, resulting in less number of complications.[7] Surgical intervention is recommended for fractures of the humerus shaft in cases of open fractures, polytrauma patients, bilateral injuries, ipsilateral forearm fractures, 'floating elbow', and compartment syndrome.[7] The advantages of surgical fixation involve being able to mobilize earlier, often with nearly immediate mobilization. The literature does not provide thorough documentation of the reasons, methods of fixation, complications, and results following surgical stabilization of humerus shaft fractures.[7] Recently, conservative treatment has been reported to be linked to a high incidence of nonunion.[8]

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In one previous study, conservative management with a functional brace was compared with surgical fixation using open reduction and internal fixation (ORIF). The main outcome measures were evaluated which included nonunion, malunion, and the incidence of radial nerve palsy. Nonunion (20.6% vs 8.7%) and malunion (12.7% vs 1.3%) were statistically significant and more common in the conservative group. Radial nerve palsy occurred in 9.5% of patients in the conservative group and in 2.7% of patients managed with ORIF after fracture treatment.[9]

The rationale of this study is to determine the outcomes of conservative treatment with a functional brace versus operative techniques using open reduction and internal fixation in managing mid-shaft humerus fracture. Mid-shaft humerus fractures are prevalent in our population and their treatment is mainly conservative as described in previous studies. However, the risk of radial nerve injury makes it necessary to review our treatment plan and generate new evidence through such research studies for formulating new guidelines for the treatment of humerus shaft fracture.

METHODS

This was a randomized controlled trial conducted at the Department of Orthopedic and Traumatology, Lady Reading Hospital, Peshawar from July 20, 2023, to January 20, 2024, for a total duration of 6 months. A consecutive non-probability sampling technique was applied using the WHO calculator for sample size with keeping 80% power of the study, 10% absolute precision, keeping malunion in the conservative group at 12.7% and in the ORIF group at 1.3%[9], sample size was 78 patients in each group, 156 patient total. Patients of both genders aged 18 to 60 with unilateral, braced, and displaced closed shaft fractures observed on X-ray were included in the study. Patients with pathological fractures, concomitant injuries to the ipsilateral upper limb, brachial plexus, internal organ, or vascular injuries requiring surgery, multiple trauma, and compartment syndrome are excluded. After obtaining approval from the hospital's ethical review board (reference no:652/LRH/MTI), patients who met the inclusion criteria were enrolled in the surgical emergency department of Lady Reading Hospital in Peshawar. We obtained written informed consent after explaining the purpose of the study. We recorded demographic data, including age, gender, and duration of injury, along with a complete medical history and physical examination. Patients were divided into two groups using blocked randomization generated by computer software. Patients in group A underwent surgical treatment. The standard procedure involved open reduction and internal fixation with anterolateral approach using a DCP plate and screws. All the patient were operated by the same surgical team. Patients were instructed to move their arm immediately after the surgery but to avoid bearing weight for 6 weeks.

In group B, patients were treated non-operatively. A functional brace applied to the affected upper limb that covers the shoulder to the elbow but allows the free motion of both joints by a trained plaster technician. Both verbal and written instructions on how to use the brace and tighten it as the swelling subsided were given to the patient. They were instructed about regular wearing of the brace till the fracture healed. Additionally, they were allowed to perform active exercises for the elbow and hand non-weight-bearing, as well as pendulum exercises for the shoulder immediately. Passive exercises for the shoulder were permitted after 3 weeks while gradual weight-bearing was allowed after 6 weeks.

After 12 weeks, we recorded the frequency of union, malunion, and radial nerve injury in both groups. The data was entered into a specially designed form and then analyzed using SPSS version 22.0. We calculated the mean and standard deviation for quantitative variables such as age and duration of injury, and calculated frequency and percentage for categorical variables like gender and outcomes. We addressed effect modifiers like age, gender, and duration of injury by stratifying the data and then applying post-stratification chi-square. We considered a p-value of less than 0.05 to indicate

statistical significance.

RESULTS

The range of age in our study was 18 to 60 years with a mean age of 39.666±12.78 years and mean duration of injury was 10.628±5.52 days in Group A and a mean age of 42.423±10.66 years and a mean duration of injury was 9.743±5.30 days in Group B. Male gender was dominant in both groups (76.9% and 71.8%) as shown in Table-I. Nonunion was observed in 2 (2.6%) patients in group A, compared to 15 (19.2%) patients in group B (P= 0.001) as indicated in Table-II. The breakdown of nonunion cases in both groups based on age, gender, and duration of injury can be found in Table-III, IV, and V, respectively.

Gender	n=78	n=78
	Group A	Group B
Male	60 (76.9%)	56 (71.8%)
Female	18 (23.1%)	22 (28.2%)
Total	78 (100%)	78 (100%)

Table-I. Frequency and percentage of gender in both groups

Nonunion	n=78	n=78	P-Value
	Group A	Group B	
Yes	2 (2.6%)	15 (19.2%)	0.001
No	76 (97.4%)	63 (80.8%)	
Total	78 (100%)	78 (100%)	

Table-II. Comparison of nonunion in both groups

Group	For Age 18-40 years		P-Value
	Nonunion		
	Yes	No	
A	2(4.9%)	39(95.1%)	0.037
B	7(20.6%)	27(79.4%)	
	For Age >40 years		
Group	Nonunion		
	Yes	No	
A	0(0%)	37(100%)	0.006
B	8(18.2%)	36(81.8%)	

Table-III. Stratification of nonunion with respect to age in both groups

Group	For Male		P-Value
	Nonunion		
	Yes	No	
A	2(3.3%)	58(96.7%)	0.010
B	10(17.9%)	46(82.1%)	
	For Female		
Group	Nonunion		
	Yes	No	
A	0(0%)	18(100%)	0.031
B	5(22.7%)	17(77.3%)	

Table-IV. Stratification of nonunion with respect to gender in both groups

For duration of injury 1-10 days			
Group	Nonunion		P-Value
	Yes	No	
A	0(0%)	39(100%)	0.011
B	7(15.2%)	39(84.8%)	
For duration of injury >10 days			
Group	Nonunion		
	Yes	No	
A	2(5.1%)	37(94.9%)	0.017
B	8(25%)	24(75%)	

Table-V. Stratification of nonunion with respect to duration of injury in both groups

DISCUSSION

The mean age of patients in our study in Group A (surgical treatment) was 39.666±12.78 years, and the mean duration of injury was 10.628±5.52 days. In Group B (non-operative treatment), the mean age was 42.423±10.66 years, and the mean duration of injury was 9.743±5.30 days. The age distribution and injury duration were relatively comparable between the groups, suggesting that these factors were not significant confounders in the analysis of treatment outcomes.

In both groups, the male gender was predominant, with 76.9% in Group A and 71.8% in Group B. This male predominance is similar to other studies that have reported a higher rate of incidence of humerus fractures among males due to their greater involvement in high-risk activities and occupations.[10,11]

Non-union was observed in only 2 (2.6%) patients in Group A compared to 15 (19.2%) patients in Group B, this finding aligns with previous research indicating higher rates of non-union in non-operatively treated humeral shaft fractures. For instance, a study by Ring et al. reported a non-union rate of approximately 15% in patients treated with functional braces.[12] Similarly, Matsunaga et al.'s meta-analysis highlighted that non-operative treatment is linked to higher rates of non-union compared to surgical intervention.[13]

The lower non-union rate in the surgically treated group can be attributed to the stability provided by ORIF, which promotes better healing conditions by maintaining proper alignment and

reducing micro-movements at the fracture site. A study by Fjalestad et al. demonstrated that ORIF significantly enhances fracture healing by ensuring rigid fixation and early mobilization.[14] Additionally, operative techniques allow for the direct visualization and anatomical reduction of the fracture, which are critical for optimal healing, as noted by Ekholm et al.[15]

On the other hand, non-operative treatment with functional braces, although less invasive and associated with fewer complications, relies heavily on the patient's adherence to the treatment protocol and their biological healing potential. The high rate of non-union observed in this group may be due to insufficient stabilization of the fracture, especially in cases where the fracture fragments are not adequately aligned or in patients with poor bone quality. A study by Zagorski et al. emphasized that nonoperative management requires strict patient compliance and frequent monitoring to ensure effective fracture healing.[16]

These findings are further corroborated by other studies. For instance, a study done by Hageman et al. found that surgical treatment of humerus shaft fractures resulted in lower non-union rates compared to nonoperative treatment.[17] Another study by Sarmiento et al. reported that while functional bracing is effective in many cases, it is associated with a higher rate of complications such as malalignment and delayed union.[9] Furthermore, another retrospective study by McKee et al. highlighted the benefits of ORIF in terms of functional outcomes and patient satisfaction, reinforcing the preference for surgical intervention in certain patient populations.[18] The choice between operative and non-operative treatment should also consider potential complications. ORIF, while effective in reducing nonunion rates, carries risks such as infection, hardware-related issues, and surgical morbidity. Conversely, non-operative treatment, though avoiding surgical risks, may lead to prolonged immobilization and functional impairment. A study by Kurup et al. compared the complication profiles of both treatment modalities, emphasizing the need for a balanced approach based on patient-specific factors.[19]

The findings of this study underscore the importance of personalized treatment plans for patients with mid-shaft humerus fractures. While ORIF provides more reliable outcomes in terms of fracture union, non-operative treatment with functional braces remains a viable option for selected patients, particularly those who have comorbidities and may be at higher risk for surgical complications. The decision should be guided by a detailed assessment of the patient's overall health, fracture characteristics, and personal preferences.

CONCLUSION

In conclusion, our study emphasizes that surgical intervention using ORIF is more effective than non-operative management with functional braces in reducing non-union rates for mid-shaft humerus fractures. The choice of treatment should be tailored to individual patient factors to achieve optimal outcomes and minimize complications associated with each approach.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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