

A Comparison of Clinical and Radiographic Outcomes in Surgical versus Nonsurgical Treatment of Humeral Shaft Fractures

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INTRODUCTION: Humeral shaft fractures represent 1-5% of all fractures and are increasing in incidence. The majority of the existing literature on humeral shaft fractures is mixed regarding outcomes of surgical versus nonsurgical management. Several recent randomized controlled trials have shown improved union rates and outcomes in patients treated surgically. However, many studies show no difference in time to clinical union (absence of pain and motion at fracture site) or ultimate range of motion (ROM) with surgical treatment, but higher rates of nonunion and malunion with nonsurgical treatment. Additionally, there is limited data showing similar functional outcomes with surgical and nonsurgical management. We hypothesized that patients treated surgically would have a faster time to radiographic union and improved functional outcomes relative to patients treated nonsurgically.

METHODS: This was a retrospective cohort study performed at a single healthcare system. All humeral shaft fractures treated between 2010-2020 were identified using ICD-9, -10, and CPT codes. Exclusion criteria were age less than eighteen, bilateral fractures, pathologic fracture, periprosthetic fracture, humeral neck fracture, intra-articular fracture, or history of a previous ipsilateral humeral shaft fracture. This resulted in a sample size of 517 patients. Seventy-nine of these patients had no follow-up information and were included in analysis of patient demographics, fracture characteristics, and initial treatment, but excluded from outcomes analysis. Information on demographics, fracture, treatment, and outcomes was collected through chart and radiograph review. These measures were compared between patients treated surgically and nonsurgically.

RESULTS: A total of 517 adult patients with unilateral humeral shaft fractures were identified, 233 were treated nonsurgically and 284 were treated surgically with open reduction internal fixation (ORIF) or intramedullary nail (IMN). Patients treated surgically had a mean age of 50.2 years relative to 59.9 years in patients treated nonsurgically ($p < 0.001$). A higher proportion of the nonsurgical group were female and unemployed than the surgical group ($p = 0.007$ and $p < 0.001$ respectively) (Table 1). Ground level fall as a mechanism of injury was significantly more common in the nonsurgical group than in the surgical group (75% of patients vs. 46.8%, relatively, $p < 0.001$). The humeral shaft fracture was also more likely to be an isolated injury in the nonsurgical group (93.1% vs. 72.5% respectively, $p < 0.001$) (Table 2). Patients treated surgically had significantly faster time to radiographic union at a median of 113 days versus 161 days in nonsurgically-treated patients ($p = 0.001$). The surgical group was made weight-bearing as tolerated at a median of 84 days, significantly less time than the nonsurgical group at a median of 98 days ($p = 0.002$) (Figure 1). There was no difference in complication rates between groups. There were no differences in range of motion at time of radiographic union. However, at time of last follow up, patients treated surgically were up to two times more likely to achieve full shoulder forward elevation than those treated nonsurgically ($p = 0.011$) (Table 3).

DISCUSSION AND CONCLUSION:

Majority of the existing literature on humeral shaft fractures compares the rate of union between different treatment modalities, but this is the first study we are aware of to examine the time to radiographic union. Additionally, there is limited literature examining functional outcomes following these injuries that largely shows no differences based on type of treatment. To our knowledge, this is the first study to measure time to WBAT as a metric in comparing outcomes of humeral shaft fractures. In this study, WBAT was achieved significantly earlier in those undergoing surgical management. Earlier weight-bearing may indicate an earlier return to work, earlier ability to perform ADLs independently, and overall improved outcomes.

To our knowledge, this is the largest single system cohort study examining outcomes in humeral shaft fractures. We found that surgical treatment of humeral shaft fractures leads to faster time to radiographic union and weight-bearing than nonsurgical treatment, without increased complications. This may allow for an earlier return to work and activity and contribute to an overall lower cost to society, however further studies are needed to examine this fully.

Table 1: Demographics of study population

The table below displays the demographics of the overall study population and of each cohort (nonoperative and operative).

Variable	Response	Overall	Nonoperative	Operative	p-value
Age (years)	Mean ± SD	54.6 ± 21.4	55.9 ± 20.9	52.2 ± 20.9	<.001
	Female	206 (99.2%)	133 (68.7%)	133 (99.9%)	
Gender	Male	211 (100.8%)	90 (54.3%)	131 (100.1%)	0.007
	Caucasian	319 (161.7%)	144 (86.3%)	175 (132.9%)	
Race	African American	162 (81.3%)	67 (39.9%)	95 (72.2%)	0.195
	Other	21 (10.5%)	11 (6.6%)	10 (7.6%)	
	Not reported	14 (7.2%)	11 (6.6%)	3 (2.3%)	
Marital Status	Single	214 (104.8%)	82 (50.3%)	132 (100.4%)	0.024
	Married	169 (82.7%)	90 (54.3%)	79 (59.7%)	
	Divorced	76 (37.6%)	38 (23.0%)	38 (28.8%)	
Hired	Widowed	34 (16.7%)	15 (9.3%)	19 (14.4%)	
	Not reported	20 (10.0%)	11 (6.6%)	9 (6.8%)	
	DMT	Median (Q1-Q3)	28.2 (23.6, 34.3)	27.5 (23.3, 31.2)	29 (24.6, 35.6)
Hand Dominance	Right	419 (209.0%)	181 (109.4%)	238 (181.6%)	0.413
	Left	31 (15.4%)	17 (10.4%)	14 (10.6%)	
	Not reported	60 (29.8%)	35 (21.5%)	25 (19.0%)	
Smoking Status	Yes	374 (187.5%)	174 (105.9%)	200 (151.4%)	0.265
	No	134 (65.7%)	58 (35.6%)	76 (57.8%)	
Insurance	Not reported	3 (1.5%)	1 (0.6%)	2 (1.5%)	
	Medicare or Medicaid	324 (162.0%)	143 (86.3%)	181 (138.4%)	0.47
	Auto or Workers Compensation	22 (10.9%)	14 (8.7%)	8 (6.1%)	
	Private	150 (75.0%)	63 (38.2%)	87 (65.7%)	
	Uninsured	162 (81.0%)	81 (49.4%)	81 (61.3%)	
Employment Status	Not reported	3 (1.5%)	1 (0.6%)	2 (1.5%)	
	Unemployed	234 (117.0%)	123 (74.4%)	111 (84.1%)	<.001
State	Employed	193 (96.5%)	84 (51.2%)	110 (83.0%)	
	Not reported	3 (1.5%)	1 (0.6%)	2 (1.5%)	

*Median and the first and third quartiles are presented due to skewed DMT data within this sample.

Table 2: Fracture Characteristics by Treatment Cohort

Variable	Response	Nonoperative	Operative	p-value
Mechanism	Ground level fall	175 (79.1%)	133 (100.0%)	<.0001
	MVA	16 (7.2%)	64 (49.2%)	
	Other	40 (17.7%)	87 (66.8%)	
Location (diaphyseal third)	Proximal	57 (24.5%)	68 (51.9%)	<.0001
	Mid	154 (66.1%)	123 (93.7%)	
	Distal	22 (9.4%)	91 (69.4%)	
Polytrauma	No	217 (93.1%)	206 (155.2%)	<.0001
	Yes	16 (6.9%)	78 (59.8%)	

Figure 1: Time to radiographic union and weightbearing by treatment cohort

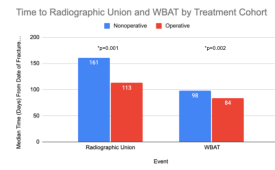


Table 3: Effect of Treatment Group on the Risk of Achieving ROM at Final Follow-Up (While Controlling for Length of Follow-Up)

The table below provides information on the probability of achieving each range of motion at final follow-up, controlling for length of follow-up.

Outcome	Comparison	Risk Ratio (95% Confidence Interval)	P-Value
Shoulder abduction > 160 degrees	Operative vs. Nonoperative	1.35 (0.96, 1.91)	0.084
	Operative vs. Nonoperative	1.48 (1.09, 2.00)	0.011
Shoulder forward flexion > 100 degrees	Operative vs. Nonoperative	0.97 (0.81, 1.16)	0.744
	Operative vs. Nonoperative	1.07 (0.96, 1.27)	0.413
Elbow extension > 5 degrees	Operative vs. Nonoperative	1.07 (0.96, 1.27)	0.413
	Operative vs. Nonoperative	1.05 (0.88, 1.19)	0.574