

Intramedullary Nail versus Plate Fixation for Diaphyseal Humerus Fractures: A Retrospective Comparative Analysis

Urvi Patel, Melissa Rose Holloway¹, Thomas Carroll, John P Ketz

¹University of Rochester Medical Center

INTRODUCTION: The purpose of this study is to analyze the outcomes following intramedullary nail (IMN) fixation versus open reduction and internal fixation (ORIF) in patients with diaphyseal humeral shaft fractures. We specifically seek to compare time to radiographic union, complication rates, operative times, operative blood loss, and functional outcomes. We hypothesize comparable outcomes between the two groups. The purpose of this study is to analyze the outcomes following intramedullary nail (IMN) fixation versus open reduction and internal fixation (ORIF) in patients with diaphyseal humeral shaft fractures. We specifically seek to compare time to radiographic union, complication rates, operative times, operative blood loss, and functional outcomes. We hypothesize comparable outcomes between the two groups.

METHODS: We retrospectively reviewed patients undergoing surgical intervention for diaphyseal humeral shaft fractures at our institution. A total of 193 patients met our inclusion criteria. Patients under the age of 18, those with impending pathologic fracture, and those with intra-articular fracture extension were excluded. Demographic characteristics, OTA fracture classification, time to union, complications, operative details, and PROMIS outcomes were reviewed and analyzed. Time to radiographic union was determined using the Radiographic Union Scores for Humeral fractures (RUSHu) scoring system. An intra-reader reliability score was measured to determine agreement between repeated evaluation of the radiographs and was calculated using the intraclass correlation coefficient (ICC). Statistical significance was set at $p < 0.05$.

RESULTS: In our cohort, 152 patients underwent ORIF and 41 patients underwent IMN fixation for their humeral shaft fracture. Mean age at time of fixation was 50 ± 20 for ORIF and 66 ± 15 for IMN ($p < 0.01$). Time to surgery averaged 5.42 ± 10.7 days and 7.52 ± 7.16 days for the ORIF and IMN groups, respectively ($p = 0.24$). Mean intraoperative blood loss was 333 ± 315 cc for the ORIF cohort and 155 ± 126 cc for the IMN cohort ($p = 0.008$). Total operative time was 214 ± 86 mins and 191 ± 58 mins for the ORIF and IMN groups, respectively ($p = 0.21$). Time to union was 17.8 ± 9.3 weeks in the ORIF group and 19.1 ± 10.6 weeks in the IMN group ($p = 0.23$). Six patients in the ORIF group and 4 patients in the IMN group went on to nonunion ($p = 0.15$). The intraclass correlation coefficient (ICC) across all reads was 0.79 (95% CI 0.77-0.82). Twenty-nine patients in the ORIF group and 2 patients in the IMN group had new-onset radial nerve palsy postoperatively ($p = 0.04$), which were significantly predicted by increased time to surgery ($p = 0.02$) and OTA fracture classification type A ($p = 0.01$). There was no significant difference in PROMIS scores across the two groups.

DISCUSSION AND CONCLUSION:

Ultimately, our study shows that IMN fixation for diaphyseal humerus fractures presents with lower rates of intraoperative blood loss and iatrogenic radial nerve injury. Factors which predicted radial nerve injuries were longer times to surgery and OTA classified type A fractures. Total operative time, time to union, PROMIS scores, and the incidence of nonunion and postoperative infections were equivocal between the two cohorts.

Table 1: Demographic characteristics and outcomes data, ORIF vs IMN cohorts.

Treatment	ORIF (n=152)	IMN (n=41)	p value
Sex			0.0002
Male	68	18	
Female	84	23	
Age (years)	49.79 (19.65)	65.90 (15.10)	0.0001
BMI	30.08 (6.63)	32.52 (8.07)	0.0503
Time to Surgery (days)	5.42 (10.70)	7.52 (7.16)	0.2370
OTA Fracture Classification			0.6738
A	98	27	
B	34	7	
C	20	7	
Injury Type			0.0062
Fall	67	24	
MVC/MCC	60	6	
GSW	5	0	
Pathologic	20	11	
Intra-Operative Blood Loss (mL)	333.38 (315.37)	155.53 (126.37)	0.0008
Total Operative Time (min)	214.19 (85.65)	191.25 (58.37)	0.2146
Time to Radiographic Union (weeks)	17.77 (9.25)	19.92 (10.60)	0.2275
Complications			
Overall Rate	61	14	0.4860
Non-Union	6	4	0.1496
Deep Infection	1	1	0.3513
Radial Nerve Injury	29	2	0.0430
PROMIS Score at 6-Month Follow-Up			
Physical Function	37.75 (9.15)	37.66 (8.97)	0.9662
Depression	52.96 (12.03)	48.58 (17.0)	0.1844
Pain Interference	59.69 (9.81)	60.53 (9.08)	0.7200

Table 2: Multivariate logistic regression, predictors of iatrogenic radial nerve injury.

Patient Factor	Coefficient B	Standard error	z	Odds Ratio (95% CI)	p value
Age (in years)	-0.01	0.01	0.75	0.99 (0.96-1.02)	.456
Gender [Male]	0.8	0.46	1.76	2.23 (0.91-5.44)	.079
Surgical Intervention [ORIF]	0.85	0.67	1.27	2.35 (0.63-8.77)	.203
Body Mass Index (kg/m ²)	0	0.03	0.02	1 (0.94-1.06)	.985
Diabetes Mellitus	1.4	0.76	1.85	4.06 (0.92-17.99)	.065
Coronary Artery Disease	-1.16	0.78	-1.49	0.31 (0.07-1.44)	.136
Hypertension	-0.17	0.55	-0.31	0.84 (0.29-2.46)	.754
Time to Surgery (in days)	0.13	0.05	2.39	1.14 (1.02-1.27)	.017
OTA Fracture Type A [vs B]	1.26	0.48	2.64	3.53 (1.38-9.01)	.008
OTA Fracture Type C [vs B]	0.63	0.68	0.93	1.87 (0.5-7.03)	.354