

Proximal Humerus Fracture Fixation Failure: A Retrospective Review*John Williams, MD¹; William Uffmann, MD¹; Joshua Harmer, BS¹;**Robert Tashjian, MD¹; Erik Kubiak, MD²**¹University of Utah, Salt Lake City, Utah, USA;**²University of Utah Department of Orthopaedics, Salt Lake City, Utah, USA*

Purpose: Proximal humerus fracture fixation has evolved over the last few decades with most fractures now being treated with locking plate fixation. Despite these advances in fixation, a large number of postoperative complications and fixation failures are observed. The aim of this study is to examine the incidence and risk factors for complications and fixation failure associated with proximal humerus fracture locking plate fixation.

Methods: We conducted a retrospective chart review of proximal humerus fracture patients seen at our Level I trauma hospital from January 2000 to July 2015. Demographic information, fracture pattern, injury mechanism, additional surgery, hardware complications including screw cutout and iatrogenic joint penetration, postoperative deep infection, postoperative arthrofibrosis, presence of osteonecrosis, and medical comorbidity data were recorded. Fisher's exact test was used to evaluate variables with statistical significance set at a P value of <0.05.

Results: 478 consecutive patients with proximal humerus fractures were identified. Those patients undergoing arthroplasty, blade plate fixation, suture fixation, intramedullary nail, or any other fixation methods were excluded. 304 patients (average age, 62.0) who underwent operative fixation with locking plate fixation were included in the study. 72 patients (23.7%) had a total of 103 complications associated with locking plate fixation. Over 77% of those complications occurred in 3- and 4-part fractures. Radiographic and clinical follow-up demonstrated postoperative collapse culminating in screw cutout and loss of reduction in 26 patients (8.6%), leading to operative intervention. The etiology was often multifactorial, with clinical and radiographic evidence showing some combination of osteonecrosis (13 patients, 4.3%), infection (9 patients, 3.0%), and nonunion (4 patients, 1.3%). Additionally, 19 patients (6.3%) had iatrogenic joint penetration noted on postoperative radiographs requiring additional surgical intervention in 3 cases. Additional surgical interventions were performed for symptomatic hardware (7 patients, 2.3%) and arthrofibrosis (9 patients, 3.0%) patients. Less common complications include reoperation for postoperative nerve palsy (1 patient, 0.33%), remote peri-implant fracture (3 patients, 1.0%), and heterotopic ossification or intra-articular graft impingement (1 patient each, 0.33%). There was no statistically significant difference between the 2 groups (complication and noncomplication groups) in Neer fracture classification. The presence of a dislocation at the time of injury ($P = 0.000659$), the use of fibular allograft at the time of surgery ($P = 0.009781$), and medical comorbidities of smoking ($P = 0.000877$), alcohol use ($P = 0.0000063$), and diabetes ($P = 0.0001$) were all statistically significant predictors of postoperative complications with locking plate fixation. Average follow-up was noted to be 187 days.

Conclusion: Proximal humerus fractures continue to present challenges in fracture fixation even with the recent increased use of locking plates. In our series of 304 patients, 72 patients

Observed Patient Characteristics in Proximal Humerus Fractures Treated with Locking Fixation

Characteristic	Failures (N=72) (%)	No Failures (N=232) (%)	P-value (p)
Fracture Type (Neer Type)			
2 Part	18 (25)	85 (36.6)	p = 0.086944
3 Part	27 (37.5)	73 (31.5)	p = 0.473286
4 Part	27 (37.5)	74 (31.9)	p = 0.315383
Associated Dislocation	13 (18.1)	11 (4.7)	p = 0.000659
Fixation Augmentation			
Fibular Allograft	8 (11.1)	7 (3)	p = 0.009781
Medical History			
Tobacco Use (any)	11 (15.3)	8 (3.4)	p = 0.000877
Alcohol Use (any)	27 (37.5)	22 (9.5)	p = 0.0000063
Diabetes	27 (37.5)	37 (15.9)	p = 0.0001
Mean Age (y)	59.4	62.1	p = 0.005899
Sex	Male	23 (31.9)	109 (47)
	Female	49 (68)	123 (53)

(23.7%) had a postoperative complication. There was a significant difference in the incidence of concomitant shoulder fracture dislocations, augmentation with fibular allograft, and medical histories remarkable for diabetes, tobacco use, and alcohol consumption in the group with noted fixation failure. Fracture dislocations are more severe injury patterns and the use of fibular allograft augmentation may be a surrogate for poor bone quality at the time of the operation, further increasing their risk for complications. In those patients deemed at high risk for proximal humerus fixation failure, arthroplasty may need to be considered given the high rates of complications noted in our series.