

## The Proximal Humerus Outcome Score at 1 Year (POSY) Predicts Which Patients Have Poor Functional Outcomes Following Operative Fixation

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**Purpose:** The ability to predict long-term outcomes following surgical fixation of proximal humerus fractures would help identify patients at risk of poor functional outcomes, for whom more aggressive treatments (i.e. shoulder arthroplasty) or more aggressive post-operative intervention may provide benefit. The purpose of this study was to develop a simple score based on preoperative data that can accurately predict functional outcomes for patients following operative management of proximal humerus fractures.

**Methods:** Over a 12-year period, 202 surgically treated proximal humerus fractures treated at a single institution were prospectively enrolled in an IRB approved database. Fractures were classified using the OTA and Neer fracture classification. All patients underwent operative fixation with locking plate and screw fixation via a standard protocol. At routine intervals, radiographic outcomes were assessed via plain radiographs and functional outcome was assessed using the Disabilities of the Arm, Shoulder and Hand (DASH). A post-operative time point of one year or greater was chosen as the predictive target of maximal functional outcome. Inclusion criteria was any patient with a minimum of 1-year functional outcome score. Patients were assigned to the poor outcome cohort if their SMFA score at that time point was greater than 10 points above the mean DASH score. Logistic regression was used to build a predictive formula for cohort membership using  $p < 0.15$  and an area under the receiver operator characteristic curve (AUROC) value was calculated to define the overall predictive capacity.

**Results:** A total of 151 (74.8%) patients with an average age of  $61.08 \pm 13.9$  met the inclusion criteria and were included in this analysis. The mean follow-up interval was 20 months and the mean DASH score was  $21.93 \pm 21.9$ . There were 36 OTA 11-A, 55 OTA 11-B, and 57 OTA 11-C fracture types. Older age ( $p = .045$ ), BMI ( $p = .026$ ), age-adjusted CCI ( $p = .001$ ), Caucasian race ( $p = .012$ ), college degree ( $p < .0005$ ), employed ( $p < .0005$ ), and worker's compensation case ( $p = .001$ ) were found to be significant predictors of poorer outcome. Fracture classification and number of fracture parts (Neer classification) were not found to be predictors of poor outcome. The significant predictors were used to create a final formula through logistic regression which predicted the probability of a poor outcome (Nagelkerke R Square = .420; Hosmer and Lemeshow = .469; AUROC = .847 (CI: 0.769-0.926). Of the 6 predictor variables, only age, worker's comp, and CCI were statistically significant. Education was only statistically significant when comparing patients with high school and postgraduate degrees. Once each patient was assigned a score, two cutoff values were defined that divided the cohort into three groups. Patients with a score lower than 20% were classified as low risk, with 6 (9.1%) of patients having a poor outcome. Patients between 20% and 50% were at intermediate risk, with 10 (31.3%) of patients having a poor outcome. High-risk patients had a score above 50%, as 18 (72.0%) of these patients had a poor outcome.

The FDA has stated that it is the responsibility of the physician to determine the FDA clearance status of each drug or medical device he or she wishes to use in clinical practice.

**Table 1. Logistic Regression Predicting Poor Outcome Group Membership**

	Sig.	Odds Ratio	95% CI for Odds Ratio	
<b>Age</b>	.465	0.978	.921	1.038
<b>BMI</b>	.334	1.039	.961	1.124
<b>Age Adjusted CCI</b>	.099	1.497	.927	2.417
<b>Caucasian Race</b>	.089	2.823	.854	1.172
<b>College Degree</b>	.068	2.897	.923	1.084
<b>Employed</b>	.040	4.202	1.067	16.550
<b>Worker's Compensation Case</b>	.015	22.820	1.829	284.764
<b>Constant</b>	.711	.443	---	---

**Conclusions:** The POSY score is a tool that can predict functional outcome at 1 year or greater following surgical intervention for a proximal humerus fracture. Patients who score above 50% are considered at high risk for a poor functional outcome. These patients should be targeted to either discuss alternative treatment options prior to surgery or be indicated for more aggressive rehabilitation following surgical intervention. In the era of value-based care, the POSY score may be used to direct resource utilization while improving outcomes.