

Risk Factors for Early Complications in the Operative Treatment of Distal Humerus Fractures in Older Patients

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Introduction

- Open reduction internal fixation (ORIF) and total elbow arthroplasty (TEA) have both been shown as valid options in the treatment of distal humerus fractures in patients over 65 years of age.
- Risk factors for early complications following these procedures have not been well described.
- This study aims to create a prediction model and identify individual risk factors to recognize patients at risk of early complications.

Methods

- We reviewed the National Surgical Quality Improvement Program for both ORIF and TEA performed for distal humerus fractures (Fx-TEA) in patients over the age of 65 years between 2006 and 2012.
- Primary TEA for patients with rheumatoid arthritis (RA-TEA) was used as a historical control for TEA complications
- We included all patient Current Procedural Terminology (CPT) codes for ORIF distal humerus fractures (24545, 24546, 24586) (the ORIF group) and TEA (24363, 24587), age 65 years and older, with ICD-9 diagnosis codes for distal humerus fracture (812.2-812.5) (the Fx-TEA group), and rheumatoid arthritis (ICD-9 code 714.0) patients over 65 years of age who had undergone TEA for non-fracture indications (the RA-TEA group).
- A backward-elimination approach was used to create prediction models, in which preoperative and intraoperative variables with $p \geq 0.30$ were dropped from the model iteratively until all predictors remaining had $p < 0.30$. Odds ratios and 95% confidence intervals were recorded.
- Significant independent risk factors had $p < 0.05$.
- Multivariate analysis in the ORIF group determined a prognostic model. The C-statistic was used to assess the fitness of the model.
- In the Fx-TEA and RA-TEA groups, univariate analysis was performed and significant ($p < 0.05$) predictors were recorded.

Table 2. Prediction model for complications in ORIF group

Predictor	Odds Ratio (95% Confidence Interval)	p
Age	1.04 (0.97 – 1.12)	.25
Weight	1.01 (1.00 – 1.02)	.21
Creatinine	2.59 (1.05 – 6.39)	.04
Preoperative Hematocrit	0.79 (0.69 – 0.90)	.0003

Table 1. Patient characteristics by treatment type (non-rheumatoid cases age 65 and older)

Pre-Treatment Variable	ORIF (n=154)	Fx-TEA (n=28)	P
Age (years)	77.8 ± 7.5	78.1 ± 7.9	.84
Sex male	25 (16.2%)	4 (14.3%)	.22
Non-independent functional status	34 (22.4%)	7 (25.9%)	.69
Smoking	16 (10.4%)	1 (3.6%)	.17
Diabetes Mellitus	39 (25.3%)	4 (14.3%)	.21
Bleeding disorder	15 (9.7%)	4 (14.3%)	.19
ASA 3 or 4	100 (64.9%)	21 (75.0%)	.30
BMI (kg/m ²)	27.4 ± 6.2	25.4 ± 4.9	.11
Weight (lbs)	158.7 ± 38.8	146.8 ± 34.7	.14
Outpatient (vs. inpatient)	31 (20.1%)	4 (14.3%)	.47
Creatinine (mg/dL)	1.02 ± 0.9	0.85 ± 0.3	.057
Hematocrit (%)	35.7 ± 4.1	35.1 ± 3.8	.52
Outcome			
Died	1 (0.7%)	1 (3.6%)	.26
Days from operation to discharge	2.6 ± 2.5	3.3 ± 3.1	.18
Bleeding	10 (6.5%)	2 (7.1%)	.30
Superficial infection	1 (0.7%)	0 (0%)	.85
Deep wound infection	1 (0.7%)	0 (0%)	.85
Dehiscence	0 (0%)	0 (0%)	na
Return to OR	5 (3.3%)	0 (0%)	.43
Deep Vein Thrombosis	2 (1.3%)	0 (0%)	.72
Nerve injury	1 (0.7%)	0 (0%)	.67

Mean ± standard deviation or N (column %) are shown.
ASA = American Society of Anesthesiologists classification system, BMI = Body mass index

Table 3. Univariate associations with outcome in patients with TEA due to fractures (Fx-TEA)

Pre-Treatment Variable	Complication (n=5)	No complication (n=23)	P
Hematocrit (%)	31.6 ± 2.6	36.1 ± 3.6	.016
Bleeding disorder	3 (60.0%)	1 (4.4%)	.011

Results

- The sample included 154 ORIF, 28 Fx-TEA, and 14 RA-TEA cases, of which, 7 were excluded in the analysis.
- The ORIF group experienced more early complications than the Fx-TEA group which included 5 reoperations, 2 infections, 1 nerve injury, and 10 cases of blood transfusions.
- The Fx-TEA group had only 2 cases of blood transfusion.
- In the ORIF group, preoperative hematocrit and creatinine were significant independent risk factors for complication.
- The final prediction model in the ORIF group was statistically significant (likelihood ratio chi-square = 32.20, $p < .0001$) with good prediction accuracy ($c = .81$). Predictors included in this model consisted of increased age, increased weight, higher preoperative creatinine, and lower preoperative hematocrit (Table 2)
- The TEA group had two independent risk factors: preoperative hematocrit and presence of a bleeding disorder, including use of anticoagulation.
- Comparing the outcome variables of the RA-TEA and Fx-TEA groups, there were no significant outcome differences.

Conclusions

- We have identified a number of risk factors that can highlight vulnerable patients undergoing ORIF and TEA treatment for distal humerus fractures. These differed among groups except for one variable, low preoperative hematocrit. ORIF can also be complicated by kidney disease. The addition of increased age and weight to the two variables of hematocrit and creatinine significantly increases a patient’s risk of complication in ORIF treatment.
- TEA risk factors were limited by a small sample size but still demonstrated two important risk factors to consider: preoperative hematocrit and presence of a bleeding disorder.
- Larger sample sizes and longer follow up are required to investigate the differences between these two treatments in the future so that we may make the best choice in treating a difficult problem.
- The NSQIP dataset limits us to only thirty days follow up and only samples a portion of orthopaedic procedures. Not all institutions participate in this program and so this is a mix of national data. It is useful for thirty-day outlooks on complications but lacks the numbers available in other databases for orthopedic procedures.
- The findings reported in this study can help understand the risk-benefit associated with both procedures.