

Utility of Frailty Index and Risk Assessment Prediction Tool in Predicting Discharge Disposition and Prolonged Length of Stay following Enhanced Recovery after Surgery Total Hip and Knee Arthroplasty

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INTRODUCTION: Frailty is a well-known risk factor for poor surgical outcomes, but there is no uniform determination or definition of physiologic frailty. Predictive tools such as the risk assessment and prediction tool (RAPT) and the 5-item modified frailty index (mFI-5) have been created to assist in discharge planning after total joint arthroplasty (TJA). The primary objective of this study was to compare the mFI to the well-established RAPT and assess their independent associations with perioperative outcomes following TJA.

METHODS: We conducted a retrospective cohort study of patients 50 years of age or older who underwent primary elective total knee or total hip arthroplasty at a single urban, academic tertiary medical center through the same Enhanced Recovery After Surgery (ERAS) protocol. Patients undergoing planned outpatient TJA were excluded. Patients were stratified using mFI-5 and RAPT scores tabulated during the preoperative clinic visit. Outcomes included complications, hospital length of stay (LOS), patient discharge disposition, and 30-day readmissions. Bivariate and multivariate analyses were conducted to assess independent associations of mFI-5 and RAPT with primary outcomes. Youden's index was utilized to construct receiver operating characteristic (ROC) curves in order to assess the predictive ability of mFI-5 and RAPT to correctly identify primary outcomes.

RESULTS: We identified 965 TJA patients: 412 THA and 553 TKA patients. Among frailty groups, 310 (32.1%) were pre-frail and 44 (4.6%) were frail. Overall, 106 (11.0%) had a more severe (RAPT <6). Patients with severe mFI had a longer LOS (3.73 days vs. pre-frail: 2.17 days vs. none: 1.74 days, $p < 0.001$) and were significantly more likely to be discharged somewhere other than home (41.9% vs. pre-frail: 16.8% vs. none: 5.57%, $p < 0.001$). However, there were no differences between frailty groups in overall complications, readmissions, or long-term mortality. On multivariable logistic regression, pre-frailty (odds ratio (OR): 1.88, $p = 0.017$) and severe frailty (OR: 6.31, $p < 0.001$) were associated with higher non-home discharge compared to no frailty, and both moderate (OR: 3.76, $p = 0.001$) and low (OR: 16.5, $p < 0.001$) RAPT scores were associated with non-home discharge compared to high RAPT scores. On multivariable linear regression, severe frailty (β : 1.56, $p < 0.001$), moderate RAPT (β : 0.38, $p = 0.002$), and low RAPT (β : 0.81, $p < 0.001$) were associated with longer LOS. RAPT was associated with acceptable discrimination of non-home discharge (AUC 0.739; 95% CI: 0.694 – 0.783), while mFI-5 was a poor predictor of non-home discharge. RAPT (AUC 0.661; 95% CI: 0.651 – 0.715) and mFI (AUC 0.683; 95% CI: 0.630 – 0.692) demonstrated acceptable discrimination for prolonged LOS, defined as LOS 2 days or more.

DISCUSSION AND CONCLUSION: The mFI-5 performs similarly to the well-established RAPT score in predicting these outcomes. Increased patient frailty and lower RAPT scores are associated with greater postoperative healthcare utilization after TJA. Utilizing the mFI5 may aid preoperative risk stratification to optimally identify candidates for same-day surgery and home discharge.

Table 1. Multivariable Regression Analysis for Outcome Measures

Variables	Non-Home Discharge		Readmission		Complication		Length of Stay	
	Odds Ratio	P-value	Odds Ratio	P-value	Odds Ratio	P-value	Estimate	P-value
mFI								
Pre-Frail	1.88	0.017	1.58	0.119	1.01	0.976	0.10	0.404
Frail	6.31	<0.001*	0.33	0.291	1.43	0.388	1.56	<0.001*
RAPT								
Moderate	3.76	0.001*	0.97	0.923	1.18	0.627	0.38	0.002*
Severe	16.5	<0.001*	0.37	0.080	1.08	0.824	0.80	<0.001*
CCI	1.18	<0.001*	1.19	<0.001*	1.18	<0.001*	0.13	<0.001*
Male Sex	1.87	0.026*	0.32	0.001	1.09	0.688	0.06	0.612
BMI	1.02	0.454	1.01	0.919	1.05	0.001*	0.05	<0.001*
Race								
Black	1.07	0.821	1.78	0.075	0.96	0.884	-0.01	0.923
Non-Black Minority	0.93	0.865	0.95	0.921	0.27	0.018*	-0.01	0.946
Revision (ref: primary)	2.74	0.001*	1.72	0.155	0.76	0.360	1.20	<0.001*
THA (ref: TKA)	1.54	0.081	1.22	0.483	1.21	0.329	-0.04	0.743

*Indicates statistical significance at $p < 0.05$

Abbreviations: RAPT = risk assessment prediction tool; CCI = Charlson Comorbidity Index; mFI-5 = 5-item modified frailty index; BMI = body mass index; TKA = total knee arthroplasty; THA = total hip arthroplasty

Table 2. ROC Curves for Dichotomous Surgical Outcomes

Variable	AUC	95% CI	Sensitivity	Specificity
Any Complication				
RAPT	0.533	0.487 – 0.578	0.642	0.420
mFI-5	0.528	0.484 – 0.572	0.405	0.640
90-Day Readmission				
RAPT	0.543	0.483 – 0.604	0.698	0.418
mFI-5	0.561	0.498 – 0.625	0.492	0.642
Non-Home Discharge				
RAPT	0.739	0.694 – 0.783	0.894	0.448
mFI-5	0.691	0.639 – 0.742	0.673	0.671
Prolonged LOS				
RAPT	0.661	0.651 – 0.715	0.734	0.549
mFI-5	0.683	0.630 – 0.692	0.512	0.772