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Modified frailty index is an effective risk-stratification tool for patients undergoing total shoulder arthroplasty

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Background: Frailty, as quantified by the modified frailty index (mFI), has emerged as a promising method to identify patients at high risk of complications after surgery. Several studies have shown that frailty, as opposed to age, is more predictive of adverse surgical outcomes. We hypothesized that a 5-item mFI could be used to identify patients at elevated risk of complications after total shoulder arthroplasty (TSA).
Methods: We identified patients aged 50 years or older who underwent TSA in the American College of Surgeons National Surgical Quality Improvement Program database. Pearson χ^2 analysis and linear regression were used to determine the association of the mFI score with 30-day postoperative complications, reoperation, readmission, length of stay (LOS), adverse hospital discharge, and mortality rate.
Results: The study included 9861 patients with a mean age of 70 years. As the mFI score increased from 0 to 2 or greater, the following rates increased: postoperative complications from 4.2% to 9.4%, readmission from 1.6% to 4.4%, adverse hospital discharge from 6.3% to 19.6%, and LOS from 1.88 days to 2.43 days ($P < .001$). Multivariate analysis showed that patients with an mFI score of 2 or greater were over twice as likely to sustain a postoperative complication (odds ratio [OR], 2.4; 95% confidence interval [CI], 1.86-3.10), readmission (OR, 2.80; 95% CI, 1.88-4.17), reoperation (OR, 1.82; 95% CI, 1.02-3.25), and adverse hospital discharge (OR, 3.14; 95% CI, 2.51-3.92). These effects were all significantly higher compared with age.
Conclusion: Frailty is associated with increased rates of 30-day postoperative complications, readmission, reoperation, adverse hospital discharge, and hospital LOS after TSA. Use of a simple frailty evaluation may help inform decision making and risk assessment when considering TSA.
Level of evidence: Basic Science Study; Validation of Outcome Instrument

Keywords: Total shoulder arthroplasty; total shoulder replacement; frailty; complications; readmission; reoperation; modified frailty index; NSQIP

Total shoulder arthroplasty (TSA) is an effective treatment for end-stage arthritis of the glenohumeral joint, with documented improvements in pain, function, and patient satisfaction.[9,15,32] The number of prosthetic shoulder arthroplasty procedures is projected to continue to increase,

Institutional review board approval was not required for this basic science study.

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in part because of improving surgical techniques and implant designs, as well as expanding indications, but also because of the increasing life expectancy and activity level of the aging population.[12,14,29,46] With this increasing use comes an increased prevalence of complications, making a comprehensive understanding of the associated risk factors for postoperative complications critical. In an environment of shared decision making, patients must be provided with an accurate risk assessment so that an informed decision can be made.[26] This information is also valuable for surgeons to mitigate risk and choose optimal treatment strategies. Furthermore, as our delivery models change toward episode-of-care models, such as bundled payments, risk stratification in the payment structures will be critical to avoid ''cherry picking'' low-risk patients. The need for risk stratification is highlighted within the current health care environment, in which the pressures for cost efficiency have precipitated the emergence of alternative value-based reimbursement models.[5]

Complication rates after TSA of up to 8% to 13% have been documented in patients.[1,3,10] Several studies have identified multiple risk factors for postoperative complications after TSA, including medical comorbidities, age, morbid obesity, American Society of Anesthesiologists (ASA) score, steroid use, preoperative anemia, increased operative time, hypoalbuminemia, and revision arthroplasty.[3,4,10,20,21,23-25,27,28,31,44,45]

Although several studies have analyzed the effect of age and comorbidities on outcomes after TSA,[20,23,44] no study has specifically examined the consequence of frailty. Frailty is a generalized, aging-associated decline in multisystem physiological reserve and function.[48] The degree of frailty may differ tremendously among patients of the same chronological age, making frailty an important consideration when attempting to analyze the effect of age on postoperative outcomes.[40,43,48]

Several studies, in both orthopedics and other surgical specialties, have shown that frailty, as quantified by the modified frailty index (mFI), is associated with an increased risk of perioperative complications and surgical outcomes.[2,7,11,30,34,36,38,39,47] The 5-item mFI is an abbreviated quantification of frailty developed as a simplified version of the extensive 70-item Canadian Study of Health and Aging Frailty Index and has been validated against other risk-stratification indices[6,17,33,41,43] (Table I). In total knee and total hip arthroplasty patients, the mFI has been shown to be associated with several 30-day complications and adverse outcomes.[7,36] The purpose of this study was to determine whether the mFI score is similarly applicable to the patient undergoing TSA. We hypothesized that increased frailty, as indicated by the 5-item mFI, would be associated with an increased risk of 30-day complications, readmission, reoperation, and hospital length of stay (LOS).

Table I Items included in 5-item mFI

Items
1. Diabetes mellitus: non-insulin, insulin, or oral
2. Congestive heart failure within 30 d before surgery
3. Hypertension requiring medication
4. History of COPD or pneumonia
5. Functional health status before surgery: partially dependent or totally dependent

mFI, modified frailty index; *NSQIP*, National Surgical Quality Improvement Program; *COPD*, chronic obstructive pulmonary disease.

Methods

Data collection

Data for patients included in this study were collected from the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database. This database comprises prospectively collected data and gathers information on patients undergoing ''major'' surgery across multiple subspecialties from both domestic and international participating hospitals. Preoperative demographic characteristics and comorbidities, as well as 30-day postoperative outcomes and complications, are collected in the database. This database has expanded rapidly in both the number of patients included and its use in the literature.[7,8,36] It is thorough and complete, successfully capturing 95% of outcome data points by using multiple data-collection methods. Random audits and employment of highly trained clinical reviewers further ensure accuracy.

In this retrospective cohort database study, the NSQIP database was queried for patients with Current Procedural Terminology code 23472: arthroplasty, glenohumeral joint; total shoulder (glenoid and proximal humeral replacement [eg, total shoulder]). Data collected from all patients from 2006-2015 were included in this study, except for those meeting the following exclusion criteria: age younger than 50 years, systemic sepsis on admission, prior operation within 30 days of TSA, emergency case, disseminated cancer, ascites, and open wound or infection. Patients younger than 50 years were excluded because frailty is associated with aging and is of less clinical relevance in young patients. The cutoff age of 50 years was used owing to precedence in the literature. In addition, in an attempt to capture only complications related to the total shoulder procedure, patients who underwent an additional procedure performed by another specialty were excluded. Finally, patients with missing data were excluded. In all, 1.9% of the original 10,051 patients aged 50 years or older undergoing TSA were excluded by this criterion. A subgroup analysis of patients aged 70 years or older was performed to evaluate the effect of frailty in this older cohort.

Baseline patient characteristics

Baseline patient information on all included patients was collected and included the following: sex, age, race, ASA classification, and body mass index (BMI). The breakdown by age was as follows: 50

to 59 years, n = 1219 (12.4%); 60 to 69 years, n = 3456 (35.0%); and 70 years or older, n = 5186 (52.6%) (Table II).

Modified frailty index

We elected to use the 5-item mFI for this study. This index was adapted from the original 11-item mFI and has been used to successfully predict complications in orthopedics and other surgical fields. Its use has been validated against the 11-item index for use in orthopedics (Spearman ρ correlation of 0.953).[11,41] The use of this 5-item index is preferable as it translates more easily to the bedside than the 11-item index and retains similar predictive power. This 5-item index includes the following patient history items, all of which are included in the NSQIP database: (1) history of diabetes mellitus, (2) congestive heart failure (CHF) (new diagnosis or exacerbation of chronic CHF within 30 days of surgery), (3) hypertension requiring medication, (4) history of chronic obstructive pulmonary disease or pneumonia, and (5) non-independent functional status (partially or completely dependent in activities of daily living within the last 30 days before surgery). The 5-item mFI score was calculated for all included patients by simply adding the number of items present in each patient (possible score of 0-5) (Table I).

Outcome and complication data

In addition to calculation of mFI scores, 30-day complication data were collected for each patient. The primary outcome was the rate of any complication (ie, percentage of patients incurring ≥1 complication). To delineate further, included complications were classified into the following broad categories: wound (wound dehiscence or other complication, not including surgical-site infection), cardiac (cardiac arrest or myocardial infarction), pulmonary (pneumonia, pulmonary embolism, or unplanned reintubation), hematologic (deep vein thromboembolism or need for transfusion), and renal (progressive renal insufficiency or acute kidney failure). In addition, Clavien-Dindo IV complications—life-threatening complications that cause end-organ dysfunction—were analyzed separately.[16] Clavien-Dindo IV complications included cardiac arrest, myocardial infarction, septic shock, pulmonary embolism, and renal failure. Furthermore, adverse hospital discharge (discharge to location other than home or the patient's preoperative living facility) and 30-day readmission, reoperation, and mortality rates were collected and analyzed.

Statistical analysis

Pearson χ^2 analysis was used to compare the incidence of complications among patients with varying mFI scores. $P \leq .05$ was considered statistically significant. Multivariate logistic analysis was then used to further examine the differing complication rates between patients with different mFI scores while controlling for potential confounding variables available for collection from the NSQIP database. This model controlled for age, sex, body mass index, total hospital length of stay, inpatient vs. outpatient status, and total operative time. In all analyses, patients with an mFI score of 0 were used as a reference group. A separate subgroup analysis was performed on patients aged 70 years or older.

Table II Baseline patient characteristics

Variable	Overall	Age ≥70 yr
n	9861	5186
Sex, %		
Male	43.4	37.7
Female	56.6	62.3
Age, mean (SD), yr	70.04 (8.67)	76.82 (4.85)
BMI, mean (SD)	31.02 (6.75)	30.03 (6.20)
BMI category, %		
Underweight (<18.5)	0.6	0.7
Normal weight (18.5-24.9)	16.2	19.3
Overweight (25.0-29.9)	32.9	35.9
Obese (30.0-34.9)	26.4	25.0
Severely obese (35.0-39.9)	13.8	11.8
Morbidly obese (≥40.0)	10.2	7.2
Race, %		
White	86.0	87.0
Black or African American	3.9	2.8
Asian, Native Hawaiian, or Pacific Islander	0.6	0.7
American Indian or Alaska Native	0.4	0.4
Unknown	9.0	8.9
ASA class, %		
1: normal healthy	1.8	0.8
2: mild systemic disease	45.5	39.6
3: severe systemic disease	50.1	56.5
4: severe systemic disease with threat to life	2.5	3.2
5: critically ill	0.0	0.0
mFI score, %		
0	27.8	21.2
1	51.9	56.8
2	18.0	19.5
3	2.1	2.3
4	0.2	0.1
5	0.0	0.1
Inpatient vs. outpatient status, %		
Inpatient	95.1	96.3
Outpatient	4.9	3.7

mFI, modified frailty index; *SD*, standard deviation; *BMI*, body mass index; *ASA*, American Society of Anesthesiologists.

Results

Patient demographic characteristics

We identified 10,051 patients who were aged 50 years or older and underwent TSA from 2006-2015 in the NSQIP database. Of these patients, 9861 met the remaining inclusion criteria and had complete data for further analysis. A slight female predominance was noted (56.6%), and the average patient was 70 years old (±8.67 years). Most patients were white (86%). Patients were most frequently overweight (BMI of 25-29.9, 32.9%) or obese (BMI of 30.0-34.9, 26.4%). In all, 5186 patients were included in the subgroup analysis comprising those aged 70 years or

Table III Rate of outcome with increasing mFI score: all included patients

Outcome	Overall, n (%) (n = 9861)	mFI score, n (%)			*P* value
		0 (n = 2741)	1 (n = 5119)	≥2 (n = 2001)	
Death	18 (0.2)	1 (0.0)	11 (0.2)	6 (0.3)	.081
Readmission	239 (2.8)	40 (1.6)	121 (2.7)	78 (4.4)	<.001*
Reoperation	104 (1.1)	22 (0.8)	54 (1.1)	28 (1.4)	.139
Any complication	602 (6.1)	114 (4.2)	299 (5.8)	189 (9.4)	<.001*
Clavien-Dindo IV complications	78 (0.8)	15 (0.5)	38 (0.7)	25 (1.2)	.023*
Infection	34 (0.3)	10 (0.4)	15 (0.3)	9 (0.4)	.585
Wound	9 (0.1)	4 (0.1)	5 (0.1)	0 (0.0)	.253
Cardiac	26 (0.3)	7 (0.3)	11 (0.2)	8 (0.4)	.391
Pulmonology	81 (0.8)	11 (0.4)	43 (0.8)	27 (1.3)	.002*
Hematologic	32 (0.3)	8 (0.3)	15 (0.3)	9 (0.4)	.544
Renal	5 (0.1)	1 (0.0)	0 (0.0)	4 (0.2)	.003*
Adverse hospital discharge	1027 (11.7)	155 (6.3)	524 (11.6)	348 (19.6)	<.001*

mFI, modified frailty index.
* Statistically significant ($P < .05$).

older. The demographic characteristics of this subgroup were not dissimilar to the overall group (Table II).

Five-item mFI scores

The mFI scores for included patients ranged from 0 to 4 of 5. However, given that 97.7% of patients had an mFI score of 0, 1, or 2 and based on precedence in the literature,[11,37,47] we performed the analysis using the following groups: mFI score of 0, mFI score of 1, and mFI score of 2 or greater. The distribution of patients with each mFI score is shown in Table II. Together, the group of patients with an mFI score of 2 or greater constituted 20.3% of patients.

Association of 5-item mFI with 30-day postoperative complications and mortality rate

The rate of any complication increased from 4.2% in patients with an mFI score of 0 to 9.4% in patients with an mFI score of 2 or greater ($P < .001$; Table III, Fig. 1). The rate of life-threatening Clavien-Dindo IV complications also increased, from 0.5% (mFI score of 0) to 1.2% (mFI score $\geq$ 2, $P = .023$). Mortality rates in patients with an mFI score of 0 vs. an mFI score of 2 or greater (0.0% vs. 0.3%) were not statistically significantly different ($P = .081$). Although the overall incidence was low, statistically higher rates of pulmonary and renal complications were associated with increasing mFI scores ($P \leq .003$). The individual rates of infection, wound, cardiac, and hematologic complications with increasing mFI scores were not statistically significant (Table III).

The mFI score was associated with an increased rate of postoperative complications even after we adjusted for patient demographic variables, LOS, inpatient vs. outpatient status, and total operative time. After controlling for these variables, we found that patients with an mFI score of 2 or greater were more than twice as likely to experience a postoperative complication (odds ratio [OR],

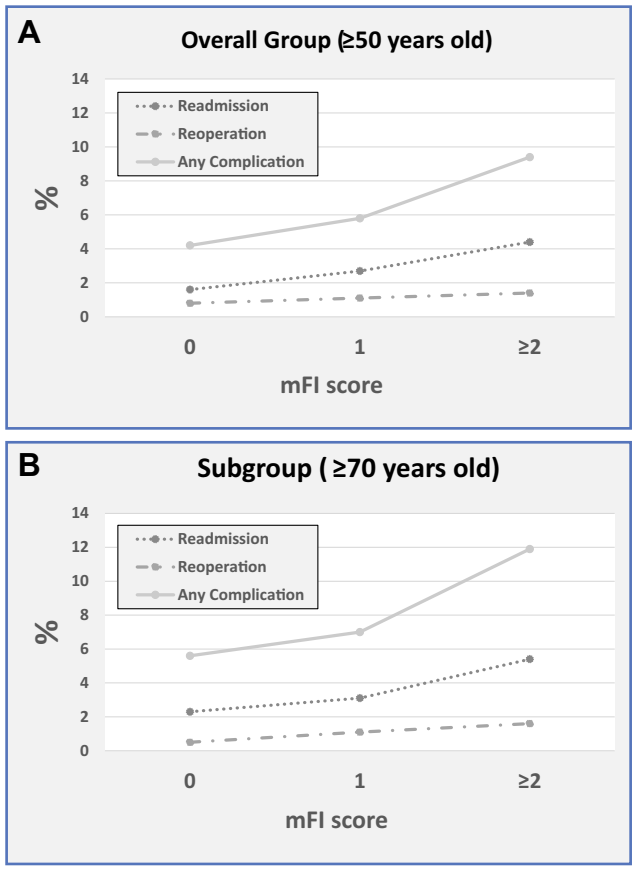

Figure 1 Rates of any complication, reoperation, and readmission in patients aged 50 years or older (**A**) and patients aged 70 years or older (**B**). *mFI*, modified frailty index.

2.40; 95% confidence interval [CI], 1.86-3.10; $P < .001$). Frailty was much more strongly associated with complications than was age (OR, 1.04; 95% CI, 1.03-1.05; $P < .001$) (Table IV). Overall, the subgroup analysis showed that increasing mFI scores yielded similar results in patients aged 70 years or older compared with the overall (aged $\geq$ 50 years) group (Table IV).

Association of mFI with 30-day reoperation, readmission, LOS, and adverse discharge

When all included patients were examined, the 30-day readmission rate increased from 1.6% to 4.4% as the mFI score increased from 0 to 2 or greater ($P < .001$). This relationship persisted in the multivariate analysis, and the mFI was found to be more strongly associated with 30-day readmission than was age; patients with an mFI score of 2 or greater had a 2.8 times higher chance of readmission (OR, 2.80; 95% CI, 1.88-4.17; $P < .001$), whereas age showed an OR of 1.05 (95% CI, 1.03-1.06; $P < .001$). Similarly, the 30-day unplanned reoperation rate increased from 0.8% to 1.4% as the mFI score increased from 0 to 2 or greater ($P = .139$; Table III, Fig. 1), and this was significant in the multivariate analysis (OR, 1.82; 95% CI, 1.02-3.25; $P = .043$).

Frailty was associated with increased LOS in both the overall group and the subgroup analysis of patients aged 70 years or older. Compared with the overall group, patients aged 70 years or older had a marginally longer LOS at each mFI cutoff, but this was not statistically significant. In patients aged 50 years or older (overall group), as the mFI score increased from 0 to 2 or greater, length of hospitalization increased from 1.88 days ($\pm$2.9 days) to 2.43 days ($\pm$2.1 days) ($P < .001$). In patients aged 70 years or older, LOS increased from 2.02 ($\pm$1.6 days) to 2.65 days ($\pm$2.4 days) as the mFI score increased from 0 to 2 or greater ($P < .001$; Fig. 2). Finally, frailty was associated with adverse hospital discharge as patients with an mFI score of 2 or greater were 3 times as likely to be discharged to a location other than home than patients with an mFI score of 0 (19.6% vs. 6.3%, $P < .001$).

Discussion

Owing to a combination of improved surgical techniques and implant designs, expanding indications, and an aging population, the need for TSA is projected to increase, with older projection models documenting a historical growth rate of 10.6% annually.[13,29] Despite its predictable pain relief and improvement of shoulder function, TSA has complication rates of up to 8% to 13%.[1,3,9,10,15,32] Although risk factors for postoperative complications after TSA have been identified in the literature, no study has specifically examined the role of frailty in the risk stratification of patients undergoing TSA. The purpose of our study was to determine whether frailty, as quantified by the mFI, is associated with increased rates of 30-day postoperative complications and adverse outcomes after TSA.

Several studies have identified multiple risk factors for postoperative complications after TSA, including medical comorbidities,[3,10,28,45] age,[20,23,44] morbid obesity,[24,25] ASA score,[3,27] steroid use,[3] preoperative anemia,[3] increased operative time,[3,45] hypoalbuminemia,[21] and revision arthroplasty.[4,31] In 1922 cases of TSA identified from the NSQIP database up to 2011, Anthony et al[3] reported an 8% rate of complications, of which over half were bleeding requiring transfusion. The high rate of transfusion, however, may be less applicable with the now proven effectiveness of routine tranexamic acid (TXA).[22,42] Two separate retrospective studies also found the Charlson Comorbidity Index (N = 127) and the ASA score (N = 452) to be significant predictors of complications.[10,27]

Of most relevance to the concept of frailty is the role of age. Several studies have suggested that older age is associated with an increased risk of serious medical complications.[20,23,44,45] In an analysis of 58,790 patients undergoing TSA or hemiarthroplasty from the Nationwide Inpatient Sample, Griffin et al[23] reported a 5-fold increase in in-hospital deaths for patients aged older than 80 years, as well as increased hospital LOS and postoperative anemia. Similarly, additional studies found that older age was a weak but independent risk factor for death (OR, 1.19; 95% CI, 1.06-1.33)[45] and thromboembolic events.[44] However, it is unclear in these studies what role frailty may have played as an uncontrolled for confounder. Age does, however, provide a protective effect regarding the need for revision surgery, as studies have shown that older age is associated with a decreased risk of mechanical failure, infection, and revision surgery compared with younger cohorts.[18,19,31,35,44] This is likely influenced by variables such as activity level, functional demands, and death before the need for revision.

Our results confirm that age is associated with postoperative complications but show that this association is weak. Frailty was much more strongly associated with postoperative complications, readmission, reoperation, and adverse hospital discharge than was age alone. Given this, the use of frailty appears to be a better risk-stratification tool than chronological age. Frailty can be defined as a generalized decline in multisystem physiological reserve and function.[48] One tool developed to quantify frailty is the mFI, which has been used extensively in both the orthopedic and general surgical literature. It has been effective in successfully risk stratifying patients for postoperative complications after surgery for femoral neck fractures[34] or distal radius fractures,[47] spine surgery,[2,30,37,39] and total hip and knee arthroplasty.[7,36,38] In hip and knee arthroplasty, the mFI outperformed age and BMI in determining several postoperative complications.[7,36,38]

Table IV Multivariate logistic regression for all complications, 30-day readmission, 30-day reoperation, and adverse hospital discharge for overall group (age ≥ 50 years) and subgroup (age ≥ 70 years)

	Any complication		Readmission		Reoperation		Adverse discharge	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Age ≥ 50 yr								
mFI score								
0	Ref	—	Ref	—	Ref	—	Ref	—
1	1.50*	1.19-1.88	1.70*	1.18-2.45	1.38	0.83-2.28	1.92*	1.57-2.34
≥2	2.40*	1.86-3.10	2.80*	1.88-4.17	1.82*	1.02-3.25	3.14*	2.51-3.92
Age	1.04*	1.03-1.05	1.05*	1.03-1.06	1.01	0.98-1.03	1.10*	1.09-1.11
Age ≥ 70 yr								
mFI								
0	Ref	—	Ref	—	Ref	—	Ref	—
1	1.33	0.98-1.81	1.44	0.89-2.33	2.10	0.87-5.07	1.29*	1.01-1.65
≥2	2.07*	1.47-2.90	2.59*	1.54-4.34	2.74*	1.05-7.12	2.14*	1.63-2.80
Age	1.05*	1.03-1.07	1.07*	1.03-1.10	1.01	0.96-1.07	1.13*	1.11-1.15

OR, odds ratio; *CI*, confidence interval; *mFI*, modified frailty index; *Ref*, reference value.
The multivariate model controlled for age, sex, body mass index, total hospital length of stay, inpatient vs. outpatient status, and total operative time.
* Statistically significant ($P < .05$).

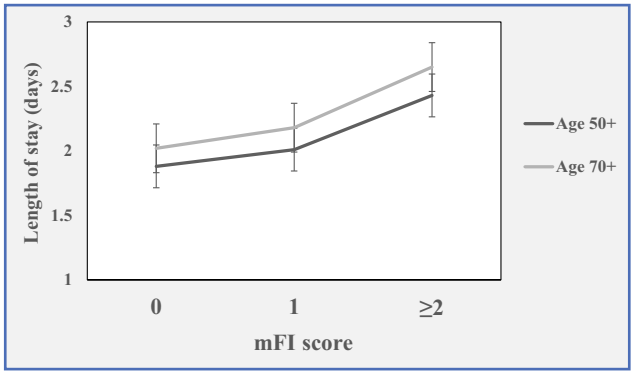

Figure 2 Length of hospital stay increased with increasing modified frailty index (*mFI*) score and was similar in the overall group and patients aged 70 years or older (mFI score of 0 vs. ≥2, $P < .001$).

This study investigated whether the mFI would be similarly valuable in determining the risk of postoperative complications after TSA. Our results confirm our hypothesis that frailty, as quantified by the 5-item mFI, is associated with complications after TSA and can be used as a simple, objective preoperative risk-assessment tool. This retrospective analysis of 9861 cases of TSA showed that as the mFI score increased from 0 to 1 to 2 or greater, so did the rate of postoperative complications, readmission, reoperation, adverse hospital discharge, and hospital LOS. Multivariate analysis confirmed that this relationship is stronger than those same relationships with age alone. Although the rates of some specific complication types were not individually statistically significant on univariate analysis (Table III), multivariate analysis showed that the frail patient (mFI score ≥ 2) has a 2.4 times increased risk of incurring any complication after TSA. In addition, the subgroup analysis of patients aged 70 years or older showed that the overall effect of frailty on postoperative outcomes was similar in the group aged 70 years or older compared with the overall (aged ≥ 50 years) group.

Similarly to other multivariable risk-stratification indices, the 5 components of the mFI may individually be more strongly or weakly associated with certain complications. For example, the CHF mFI component may be more strongly linked with cardiac complications, whereas the hypertension and diabetes mFI components may be more closely associated with renal complications. However, in our results, the mFI components are additive; as such, the mFI score shows the cumulative effect of increasing frailty and provides a simple risk-assessment tool for the clinician.

The reason for using the abbreviated 5-item mFI rather than the 11-item mFI was 3-fold. First, complete data were available for the 5-item mFI for all 9861 patients, whereas the use of the 11-item mFI would have necessitated a significant amount of attrition for incomplete data. Second, the 5-item index has been established in the literature and has been validated against the 11-item mFI.[41] Third—and most important—our aim was to identify a simple and clinically applicable tool that would be feasible for the everyday clinician to integrate into his or her practice. A recent study showed the effectiveness of the Elixhauser Comorbidity Measure in predicting inpatient complications and resource utilization after TSA; however, the 30-item index and complex scoring system may be too cumbersome for routine bedside use.[28] On the contrary, with a simple count of the 5 readily available and memorable variables of the mFI (Table V), clinicians can use the index immediately at

Table V Mnemonic for use in total shoulder arthroplasty

SHoulder REPlacement mnemonic
Status (non-independent functional status)
Heart failure
Respiratory pathology (COPD or pneumonia)
Elevated Glucose (diabetes mellitus)
Pressure elevation (hypertension)

COPD, chronic obstructive pulmonary disease.

the bedside to discuss individualized risks with patients. This allows physicians to account for the heterogeneity of the elderly population's physiological reserve rather than relying on age alone as a surrogate.

Several important limitations exist in this study, most of which are inherent to retrospectively analyzing a large database. First, complications and outcomes are tracked for only 30 days postoperatively in the NSQIP database, thereby likely artificially depressing the reported rate of complications and failing to capture several midterm to long-term complications. In addition, as the NSQIP is a generalized surgical database, several outcomes of specific orthopedic interest are not included, such as mechanical failure, prosthesis survival, range of motion, and shoulder function scores. As is often the case in similar studies, little detail exists within the database as to the underlying reason for certain outcomes such as prolonged LOS, reoperation, or readmission. Owing to the nonspecific nature of procedural codes available in the NSQIP database (Current Procedural Terminology code 23472), we were unable to distinguish between standard and reverse arthroplasty designs. In addition, our study does not take into account the diagnosis code for which TSA was performed, introducing population heterogeneity as patients with glenohumeral osteoarthritis, proximal humeral fractures, rotator cuff arthropathy, or massive irreparable cuff tears potentially represent different patient populations and clinical scenarios that warrant different discussions of risks vs. benefits and alternative treatment options.

Conclusion

Frailty, as quantified by the 5-item mFI, is strongly associated with increased rates of 30-day complications, readmission, reoperation, adverse hospital discharge, and hospital LOS after TSA in patients aged 50 years or older. Although TSA generally provides adequate pain reduction and shoulder function, frail patients may be at increased risk of early postoperative complications and adverse outcomes. The proposed mFI is an effective, practical, and clinically applicable risk-assessment tool that may help guide preoperative counseling and decision making in patients considering TSA. Future studies may aim to prospectively validate the mFI, track long-term and orthopedic-specific outcomes, or specifically assess a more homogeneous population in terms of implant type and diagnosis.

Disclaimer

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