Analysis of 90-Day Readmissions After Total Shoulder Arthroplasty

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Background: The number of total shoulder arthroplasty (TSA) procedures performed annually is increasing as a result of an aging population and an increased access to subspecialty-trained upper extremity arthroplasty surgeons. An up-to-date analysis of the incidence of, risk factors for, and reasons for 90-day readmissions in primary anatomic TSA has yet to be performed.

Purpose: To characterize 90-day readmissions on a national level. An understanding of these data will help to predict resource utilization and expenses in shoulder arthroplasty.

Study Design: Case-control study; Level of evidence, 3.

Methods: All adult patients undergoing elective primary TSA in 2014 who were included in the National Readmission Database were included in the analysis. Two cohorts were created according to 90-day readmission status. Multivariable analysis was then performed to determine predictors of 90-day readmissions. Reasons for 30-, 60-, and 90-day readmissions were identified, and total hospital resource utilization was calculated.

Results: An estimated 26,023 patients were identified. The 30-, 60-, and 90-day rates of readmissions were 0.6%, 1.2%, and 1.7%, respectively. There was no difference in comorbidity burden between the cohorts. Medicare payer status (odds ratio [OR], 1.63; 95% CI, 1.00-2.65; $P = .05$), transfer to a skilled nurse facility (OR, 1.50; 95% CI, 1.05-2.14; $P = .02$), and chronic obstructive pulmonary disease (OR, 1.32; 95% CI, 1.04-1.66; $P = .02$) were identified as predictors of 90-day readmission. Female sex decreased odds of 90-day readmission (OR, 0.72; 95% CI, 0.59-0.87; $P = .001$). Ninety-day readmissions were associated with significant cost increases ($P < .001$). The most common identifiable reason for related readmissions was a hardware-related complication at all time points.

Conclusion: While uncommon, 90-day readmissions after primary TSA are associated with significant patient morbidity and ultimately substantial hospital costs. Truncating readmission analysis at a 30-day period will miss most arthroplasty-related hospital readmissions.

Keywords: shoulder arthroplasty; 90-day outcomes; cost; readmission; primary; complications

The number of total shoulder arthroplasties (TSAs) performed annually is increasing as a result of an aging population and an increased access to subspecialty-trained upper extremity arthroplasty surgeons. From 1998 to 2011 alone, the annual number of TSAs performed increased from 18,000 cases to 68,000.[28] A recent study further demonstrated that from 2011 to 2014, the incidence of shoulder arthroplasties increased by another 24%.[23] A multitude of studies have confirmed that TSA is a cost-effective treatment option for pain relief and dysfunction, which results in substantial improvements in patient satisfaction scores.[16,18,21,29] Importantly, excellent long-term survivorship of implants has additionally been demonstrated in the setting of TSA.[5,26]

The payment landscape in hip and knee arthroplasty has shifted from a fee-for-service model to a value-based reimbursement model. The United States (US) Centers for Medicare and Medicaid Services have subsequently

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One or more of the authors has declared the following potential conflict of interest or source of funding: S.J.H. has received consulting fees from Zimmer Biomet. AOSSM checks author disclosures against the Open Payments Database (OPD). AOSSM has not conducted an independent investigation on the OPD and disclaims any liability or responsibility relating thereto.

Ethical approval for this study was waived by the Mayo Clinic.

The Orthopaedic Journal of Sports Medicine, 7(9), 2325967119868964
DOI: 10.1177/2325967119868964

introduced multiple fixed-payment models that have demonstrated satisfactory outcomes in certain arthroplasty settings.[7,11,20,25] Examples include the Bundled Payments for Care Improvement model, which reimburses a fixed amount for all services rendered during a predetermined period of care (eg, 3 days prior to surgical admission) to include up to the 90-day postoperative period.[11] Given the relative success of these payment models in the aforementioned settings, their implementation in other common surgical settings, such as TSA, is inevitable.[13,16,22]

In light of the upcoming implementation of these cost-containment initiatives in TSA and the potential interest of surgeons and institutions in participation, an adequate characterization of the 90-day postoperative course is valuable. Furthermore, identification of specific modifiable risk factors for complications and subsequent readmissions would offer significant utility. While some pertinent data have emerged in recent years, limitations in prior study designs offer opportunity for further analyses. We thus utilized the National Readmission Database (NRD), a relatively new database that encompasses approximately 60% of all hospital readmissions in the US, in an attempt to offer further insight into the incidence of, risk factors for, and reasons for 90-day readmissions in primary TSA. We hypothesized that 90-day readmission rates would be low in the setting of primary anatomic TSA. Furthermore, we hypothesized that readmissions, when they occurred, would most commonly be medically related.

METHODS

Study Population Selection

We performed a retrospective cohort study utilizing 2014 data from the NRD, which accounts for approximately 17 million US hospitalizations each year. This data set is constructed from 27 state inpatient databases accounting for 56.6% of all US hospitalizations. Institutional review board exemption was obtained from our institution for this study.

Inclusion and Exclusion Criteria

By utilizing procedure codes from the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM),[31] all adult patients (>18 years of age) undergoing primary anatomic TSAs were identified. Reverse (ICD-9-CM code 81.88) and partial (ICD-9-CM code 81.81) shoulder arthroplasties were excluded. Nonelective admissions were excluded. The patients were then divided into 2 cohorts based on whether they were readmitted within 90 days of the index hospitalization.

Patient and Hospital Characteristics

Patient characteristics were obtained from the NRD. These included demographic information (age, sex, and race), diagnoses, and payer type. Furthermore, the NRD allows for the evaluation of the size and teaching status of hospitals in participation.

Preoperative comorbidities were identified through ICD-9-CM and diagnosis-related group coding with the Healthcare Cost and Utilization Project (HCUP) Comorbidity Software. This software package identifies 29 patient comorbidities based on an Elixhauser Comorbidity Index, which was calculated for each patient. Only commonly occurring comorbidities (occurring in >1% of our sample population) were selected for use in our statistical analysis. Comorbidity burdens were calculated with both the Elixhauser Comorbidity Index and the Charlson Comorbidity Index.

Patient Outcomes and Readmission Analysis

The clinical classifications software was used to identify the underlying diagnoses for readmissions. The software groups related ICD-9-CM codes to facilitate statistical analysis.[12] The most common of these diagnoses were then evaluated.

Unique to the family of HCUP-produced data sets, the NRD allows for the analysis of readmissions through patient-specific identifiers. This allows for the longitudinal tracking of patients and their readmissions within the year of interest and across their state of residence. However, should the patient be readmitted to another facility in a different state, the readmissions are then lost and ultimately coded as index admissions. Furthermore, these identifiers do not carry over from year to year in the NRD. Consequently, to capture 90-day readmissions, patients admitted during the last quarter of 2014 were excluded. In addition, any mortality during the index admission was excluded from the readmission analysis. We then quantified the following metrics: (1) the incidence of 90-day readmissions, (2) the primary diagnoses associated with the readmission, and (3) any procedure performed during the readmission. We performed the same analyses for 30- and 60-day readmissions to allow for comparison.

Length of Stay and Hospital Costs

Hospital length of stay and total hospital costs were evaluated. Hospital costs (in 2014 US$) were calculated by utilizing the cost-to-charge ratios provided by the HCUP.[6] Costs were then adjusted for inflation with the Consumer Price Index. Aggregate hospital costs were recorded for patients who were readmitted by calculating the sum of the cost of the index hospitalization and the cost of the readmission.

Statistical Analysis

SPSS (v 24; IBM Inc) was used for all analyses. The chi-square test was used for categorical variables, and the independent Student *t* test was used to assess continuous variables with post hoc Bonferroni correction. Multivariable logistic regression analysis was then used for the analysis of associations between patient demographic characteristics and comorbidities and the risk of 90-day readmissions. Only covariates found to have statistically significant associations with 90-day readmissions based on univariate analysis were included in the multivariable analysis. Hospital characteristics were additionally included in the multivariable analysis to further control for confounding. These calculated associations were reported as adjusted odds ratios (ORs) with 95% CIs. $P < .05$ was set as our measure of statistical significance.

RESULTS

Patient and Hospital Characteristics

A total of 26,023 patients undergoing primary TSA were identified. Patients who were readmitted were 1.1 years younger than those who were not readmitted (66.2 vs 67.3 years; $P = .009$). There was no difference in comorbidity burden between the cohorts. Patients who were readmitted, however, were more likely to carry the diagnosis of chronic obstructive pulmonary disease (21.4% in readmitted group vs 17.6% in nonreadmitted group; $P = .032$). Further details regarding patient and hospital characteristics of the 2 cohorts are presented in Tables 1 and 2.

TABLE 1
Characteristics of Patients Undergoing Readmission at 90 Days[a]

Parameter	Nonreadmitted (n = 25,570)	Readmitted (n = 453)	P Value
Age,[b] y	67.3 ± 9.5	66.2 ± 9.3	**.009**
Female	13,128 (51.4)	199 (43.9)	
Disposition of patient			.079
Routine	18,826 (73.6)	310 (68.4)	
Transfer to short-term hospital	1966 (7.7)	39 (8.6)	
Other (SNF, ICF)	4779 (18.7)	103 (22.7)	
Primary payer			**.011**
Medicare	16,630 (65.0)	275 (60.7)	
Medicaid	693 (2.7)	21 (4.6)	
Private insurance	7028 (27.5)	142 (31.4)	
Self-pay/other	1194 (4.7)	15 (3.4)	
Hospital size[c]			.056
Small	5959 (23.3)	109 (24.1)	
Medium	6608 (25.8)	137 (30.2)	
Large	13,003 (50.9)	207 (45.7)	
Hospital type			**.008**
Metropolitan nonteaching	6774 (26.5)	147 (32.5)	
Metropolitan teaching	16,969 (66.4)	283 (62.5)	
Nonmetropolitan teaching	1827 (7.1)	23 (5.1)	
Ownership of hospital			**.013**
Government, nonfederal	2790 (10.9)	62 (13.7)	
Private, nonprofit	19,734 (77.2)	323 (71.7)	
Private, investor owned	3046 (11.9)	68 (15.0)	

[a]Values are presented as n (%) unless noted otherwise. Bold indicates statistically significant difference between groups ($P < .05$). ICF, intermediate care facility; SNF, skilled nursing facility.

[b]Mean ± SD.

[c]Based on number of beds in hospital. Number of beds varies per region and hospital type and are presented as ranges within the National Readmission Database. Number of beds in small hospital: 1-49, 1-124, and 1-249 for rural, urban nonteaching, and urban teaching, respectively. Number of beds in medium hospital: 25-99, 75-199, and 200-424 for rural, urban nonteaching, and urban teaching, respectively. Number of beds in large hospital: 100+, 175+, and 450+ for rural, urban nonteaching, and urban teaching, respectively.

Rates and Predictors of Readmission

Results of the multivariable logistic regression are shown in Table 3. Mean length of stay for the index admission was slightly shorter in the 90-day readmitted cohort (0.2 day less; $P = .003$). The 30-, 60-, and 90-day rates of readmissions were 0.6%, 1.2%, and 1.7%, respectively. Medicare payer status (OR, 1.63; 95% CI, 1.00-2.65; $P = .05$), postoperative transfer to a skilled nurse facility (OR, 1.50; 95% CI, 1.05-2.14; $P = .024$), discharge home with home health (OR, 1.40; 95% CI, 1.11-1.77; $P = .004$), and chronic lung disease (OR, 1.32; 95% CI, 1.04-1.66; $P = .02$) were identified as independent predictors of 90-day readmission. Female sex decreased odds of 90-day readmission (OR, 0.72; 95% CI, 0.59-0.87; $P = .001$).

Total Hospital Cost and Reasons for Readmission

Ninety-day readmissions were costly, with patients who were readmitted incurring total hospital costs of $82,348, as opposed to $16,621 for patients who were not readmitted ($P < .001$). The most common reasons for readmission at 30, 60, and 90 days were hardware-related complications (Table 4): 96.4%, 85.6%, and 73.1%, respectively. The most common hardware-related complication was prosthetic dislocation, with rates of 49.6%, 44.3%, and 37.0% at 30, 60, and 90 days. At the same time intervals, 84.2%, 77.7%, and 64.9% of patients being readmitted consequently required a revision TSA, and 0.0%, 9.4%, and 12.4% of patients underwent conversion of the total shoulder to a reverse TSA.

DISCUSSION

As the number of TSAs performed annually continues to increase, inclusion of TSA into bundled payment models is inevitable. In these particular payment models, health care providers and institutions may be held financially liable if costs are in excess of a predetermined payment amount. Amid these policies, hospital readmissions have been identified as a key quality metric and, consequently, a basis for financial penalty. For example, in 2014, in the second year of the Medicare Hospital Readmissions Reduction Program, 2610 hospitals were fined $428 million for excess all-cause readmissions.[2] Conversely, providers and hospitals may be rewarded if cost savings occur. Importantly, these financial responsibilities are enforced regardless of the relationship between the readmission and the index procedure and can extend to include up to the 90-day postoperative period.[4] Consequently, a more thorough characterization of 90-day readmissions is prudent to improve patient care and cost-effectiveness and

TABLE 2
Factors Associated With Patient Readmissions at 90 Days[a]

Factor	Nonreadmitted (n = 25,570)	Readmitted (n = 453)	*P* Value
Alcohol	282 (1.1)	3 (0.7)	.497
Deficiency anemias	1372 (5.4)	15 (3.3)	.063
Rheumatoid arthritis/ collagen vascular disease	1173 (4.6)	18 (4.0)	.640
Chronic blood loss anemia	111 (0.4)	0 (0.0)	.271
Congestive heart failure	590 (2.3)	12 (2.7)	.634
Chronic pulmonary disease	4492 (17.6)	97 (21.4)	**.032**
Coagulopathy	337 (1.3)	9 (2.0)	.210
Depression	3819 (14.9)	74 (16.3)	.389
Diabetes, uncomplicated	4324 (16.9)	81 (17.9)	.573
Diabetes with chronic complications	485 (1.9)	6 (1.3)	.485
Drug abuse	178 (0.7)	0 (0.0)	.080
Hypertension	16,731 (65.4)	313 (69.1)	.112
Hypothyroidism	3914 (15.3)	61 (13.5)	.322
Liver disease	327 (1.3)	8 (1.8)	.393
Lymphoma	81 (0.3)	0 (0.0)	.408
Fluid/electrolyte disorder	1236 (4.8)	27 (6.0)	.268
Metastatic cancer	18 (0.1)	0 (0.0)	>.99
Other neurological disorders	1217 (4.8)	18 (4.0)	.498
Obesity	5166 (20.2)	77 (17.0)	.100
Paralysis	90 (0.4)	3 (0.7)	.220
Peripheral vascular disease	673 (2.6)	10 (2.2)	.766
Psychoses	585 (2.3)	14 (3.1)	.264
Pulmonary circulation disorders	211 (0.8)	3 (0.7)	>.99
Renal failure	1278 (5.0)	21 (4.6)	.816
Solid tumor without metastases	130 (0.5)	2 (0.4)	>.99
Peptic ulcer disease	2 (0.0)	0 (0.00)	>.99
Valvular disease	986 (3.9)	23 (3.9)	.173
Weight loss	29 (0.1)	0 (0.0)	>.99
Tobacco use	1870 (7.3)	34 (7.5)	.865
Elixhauser Comorbidity Index[b]	–0.54 ± 4.9	–0.17 ± 4.78	.099
Charlson Comorbidity Index[b]	0.65 ± 1.0	0.67 ± 1.10	.570

[a]Values are presented as n (%) unless noted otherwise. Bold indicates statistically significant difference between groups ($P < .05$).
[b]Mean ± SD.

TABLE 3
Independent Predictors of 90-Day Readmissions[a]

Factor	Odds Ratio	*P* Value
Chronic pulmonary disease	1.32 (1.04-1.66)	**.020**
Female	0.72 (0.59-0.87)	**.001**
Disposition of patient		
Routine	Reference	
Transfer to skilled nursing facility	1.50 (1.05-2.14)	**.024**
Transfer to short-term hospital	1.00 (1.11-1.76)	**.004**
Primary payer		
Self-pay/other	Reference	
Medicare	1.63 (1.00-2.65)	**.050**
Medicaid	1.18 (0.93-1.50)	.167
Private insurance	0.69 (0.40-1.18)	.172
Ownership of hospital		
Government, nonfederal	Reference	
Private, nonprofit	0.72 (0.55-0.95)	**.020**
Private, investor owned	0.91 (0.64-1.31)	.625
Hospital type		
Metropolitan nonteaching	Reference	
Metropolitan teaching	0.78 (0.63-0.96)	**.019**
Nonmetropolitan teaching	0.62 (0.40-0.97)	**.038**

[a]Bold indicates statistically significant difference between groups ($P < .05$).

TABLE 4
Reasons for Patient Readmissions at 30, 60, and 90 Days[a]

	30 d (n = 165)	60 d[b] (n = 319)	90 d[b] (n = 453)
Complications of device[c]	159 (96.4)	273 (85.6)	331 (73.1)
Dislocation of prosthetic joint	82 (49.6)	141 (44.3)	168 (37.0)
Mechanical loosening of prosthetic joint	18 (10.9)	21 (6.6)	29 (6.4)
Periprosthetic joint fracture	10 (6.1)	13 (4.1)	13 (2.9)
Acute posthemorrhagic anemia	22 (13.3)	54 (16.9)	79 (17.4)
Postoperative infection	4 (2.4)	6 (1.9)	6 (1.3)
Wound dehiscence	4 (2.4)	4 (1.3)	4 (0.8)
Deep venous thrombosis	8 (4.9)	16 (5.0)	30 (6.6)
Acute renal failure	8 (4.9)	11 (3.5)	11 (2.4)
Urinary tract infection	5 (3.0)	7 (2.2)	7 (1.6)
Septicemia	3 (1.8)	3 (0.9)	3 (0.7)
Pulmonary embolism	0 (0.0)	3 (0.9)	3 (0.7)
Pneumonia	0 (0.0)	0 (0.0)	2 (0.4)
Acute myocardial infarction	0 (0.0)	0 (0.0)	0 (0.0)
Cerebrovascular accident	0 (0.0)	0 (0.0)	0 (0.0)

[a]Medical reasons were the most common reasons for readmission. However, diagnoses included hypertension, gastroesophageal reflux disease, hyperlipidemia, and depression (ie, likely unrelated to index hospitalization/event). Values are presented as n (%).
[b]Cases in each column are cumulative (ie, include all cases from previous readmission time points).
[c]Identified through the Healthcare Cost and Utilization Project clinical classification software. Includes multiple diagnoses, such as dislocation and mechanical loosening.

to potentially aid in policy formation. Our study was the first large national study to present more current 90-day readmission metrics in the setting of primary TSA alone.

Our 90-day readmission rate following primary TSA was 1.7%. In a large single-institution series that included 1440 primary TSAs, Streubel et al[30] reported an incidence of 90-day readmission of approximately 1%. In a large comparative analysis based on Medicare data, Basques et al[3] reported a 90-day readmission rate of 2.9% following inpatient TSA. Schairer et al[27] performed a similar analysis utilizing the state inpatient database from 7 states and found a 90-day readmission rate of 6.0% for TSA between 2005 and 2010. The latter 2 studies, however, included reverse TSAs in their analyses, as a specific ICD-9-CM procedure code for this procedure was not implemented until

2011. This may account for the noticeable difference in rates of readmission. Additionally, as these studies were conducted in data sets that are almost a decade old, additional confounding may have existed regarding interval improvements in the identification of high-risk patients and consequent preoperative medical optimization. Finally, our study excluded fractures[1,17,19] and included both Medicare and non-Medicare patients, which may have further influenced our readmission rates.

Risk factors for readmission after TSA, although somewhat inconsistent in nature, have previously been identified. Lovy et al[16] found that inflammatory arthritis, male sex, age, increased American Society of Anesthesiologists class, and functional status were all independent risk factors for readmission at 30 days. Schairer et al[27] found that male sex, Medicaid payer status, transfer to a skilled facility, and higher comorbidity burden were all associated with increased risk of readmission at 90 days. Basques et al[3] found that chronic obstructive pulmonary disease and advanced age (>85 years) were risk factors for 30-day readmission following outpatient TSA. Again, while there were some noticeable differences in the risk factors identified, our study similarly found that male sex, chronic lung disease, and transfer to a skilled facility were all associated with an increased risk of 90-day readmission. Our study uniquely expanded the associations between these characteristics and the likelihood of 90-day readmissions to all payer types on a national scale, while controlling for a multitude of patient- and hospital-related confounding factors. Finally, additionally unique to our study, we found that patients who had surgery at a teaching hospital had a lower likelihood of 90-day readmission.

While we identified that medical diagnoses (eg, hypertension, gastroesophageal reflux disease, hyperlipidemia) as a whole were more commonly coded for than surgical diagnoses in our readmissions data, surgical diagnoses were still the most common readmission diagnoses related to the index shoulder arthroplasty. Hardware-related complications were the most common reasons for readmission at all time points, with 73% of all readmissions at 90 days being surgically related. Dislocation was the most common specific complication noted at this time point, with an incidence of 37%. Consequently, 64.9% and 12.4% of readmitted patients required a revision TSA or reverse TSA, respectively, by 90 days. It is important to clarify that while these rates appear disproportionately large in the context of readmissions, they actually represent a very small percentage of the entire patient sample. For instance, in the context of all patients who underwent shoulder arthroplasty, the incidence of dislocation was only 0.6%.

On the contrary, Basques et al[3] identified medical complications as the most common reasons for readmission (incidence of dislocation among all 90-day readmissions, 8.4%; surgical site infection, 18.0%). Importantly, their study was conducted with Medicare claims data, which have been shown to be fairly inaccurate at adequately capturing complications.[15] Furthermore, as our data were more recent, the discrepancy in results may have additionally reflected interval improvements in the identification and medical optimization of higher-risk patients as discussed earlier. Nevertheless, our findings are certainly encouraging, as we identified that TSAs have an acceptably low risk of medical complications in the 90-day postoperative period.

More reflective of our findings, Lovy et al,[16] using the American College of Surgeons National Surgical Quality Improvement Program (NSQIP), found reoperations to be the most common reason for readmission at 30 days (40%), with instability (7.6%) representing a more common surgical diagnosis than infection (5.1%). While this rate of instability is lower than what we found, unlike the NSQIP, the NRD is unique in that it allows for the tracking of patients throughout the entirety of each geographical state and, as such, may allow for a more accurate depiction of the actual incidence of prosthetic dislocation in this setting. Streubel et al[30] also found that the most common reason for reoperation in the 90-day postoperative period of their patient population was instability (40%), followed by infection (20%).

It is important to comment on the perceivably low rate of postoperative infections identified in our study. The published rate of prosthetic shoulder infections is approximately ≤1%.[24] However, the majority of these infections are caused by low-virulence organisms (eg, *Cutibacterium acnes*) and are therefore most commonly diagnosed outside the acute postoperative window (ie, >3 months). Consequently, our 90-day readmission analysis would have inherently excluded such infections. Furthermore, we did not include fractures, reverse TSAs, or revision procedures in our analysis, all of which may be associated with higher rates of prosthetic joint infections.[24]

Finally, readmissions secondary to complications such as myocardial infarction and stroke were nonexistent in our study. Upon initial review of our data, this was surprising. However, the rates of these complications in the setting of shoulder arthroplasty are intrinsically low (<1%).[8,14] Furthermore, it is important to note that as numerous studies have quantified the incidence of immediate postoperative complications in the setting of shoulder arthroplasty, we chose to focus only on reasons for 90-day readmissions and did not include the initial inpatient complication profile in our cumulative analysis. For instance, we identified 25 acute myocardial infarctions (0.1%) and 17 cerebrovascular accidents (0.1%) that occurred during the initial hospitalization that were not captured in our 90-day readmission analysis. These rates are in line with recently published studies.[8,14] These data may suggest that the majority of these complications occur in the immediate postoperative period and rarely after initial discharge from the hospital.

There are several notable limitations to our retrospective study. Our NRD analyses were limited to the 90-day postoperative period and would not capture any complications of inpatient primary TSAs presenting beyond this time frame. As the NRD captures only inpatient procedures, this analysis did not include any outpatient shoulder arthroplasties. Furthermore, the interpretation of the NRD requires the use of ICD-9-CM coding, which has been shown in some studies to lack in sensitivity and specificity.[9,10] The assessment of intraoperative factors (blood loss, surgical time, surgeon) or accurate evaluation of preoperative factors, such as laboratory values, were not possible. It is also important to comment that while diagnoses associated with readmissions were identifiable, at best these may be interpreted as strong associations and certainly do not establish causality. Similarly, while correlations between various characteristics and 90-day readmissions were noted, establishing root causality is not possible with the NRD given the relative lack of granularity in the database. Future prospective studies are warranted to address these limitations.

The NRD is uniquely structured in that it does not allow for the combining of yearly data sets for the analysis of larger aggregate samples, and as such, we limited our data analysis to a more recent year. Additionally, tracking of patients across geographic states is not possible in the NRD. Consequently, some patients may have been lost in the readmission analysis.

Effort was put forth to analyze any temporal trend in the rates of readmission. However, the inclusion of data beyond 90 days would have subjected our analysis to increasing seasonal bias owing to the increasing number of patients lost in the overall sample. As such, the effort was abandoned. Finally, intrinsic to the study design, the findings within this study are associations only and do not prove causality. Nevertheless, the use of the large NRD data set is also a major strength of this study, as it allowed for the analysis of rare outcomes, such as 90-day readmission, in a relatively benign surgical setting such as primary TSA.

CONCLUSION

While the incidence of 90-day readmission following primary TSA appears low, these readmissions may be associated with significant patient morbidity and high reoperation rates. This ultimately translates into substantial increases in associated hospital costs. Knowledge of both the factors that increase the likelihood of 90-day readmissions and the reasons for readmission will ideally allow for improvements in the efforts to mitigate these financially and physiologically costly readmissions. It is important to note that truncating readmission analysis at a 30-day period will miss most of the arthroplasty-related hospital readmissions.

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