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ORIGINAL ARTICLE

Outpatient total shoulder arthroplasty: a population-based study comparing adverse event and readmission rates to inpatient total shoulder arthroplasty

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Background: The rate of total shoulder arthroplasty (TSA) is rising, which has an impact on health care expenditure. One avenue to mitigate cost is outpatient TSA. There are currently no published reports of this practice. In this study, we determine the 30-day adverse event and readmission rates after outpatient TSA and compare these rates with inpatient TSA.
Methods: A retrospective cohort study using a population database in the United States was undertaken. Patients who underwent primary TSA between 2005 and 2014 were identified and divided into 2 cohorts based on length of stay (LOS): outpatient TSA (LOS 0 days) and inpatient TSA (LOS >0 days). Patient and procedure characteristics were collected. The 30-day adverse event and readmission rates were calculated for each cohort. A multivariate logistic regression determined if the odds of an adverse event or readmission were significantly different between the inpatient and outpatient TSA cohorts.
Results: Overall, 7197 patients in this database underwent TSA between 2005 and 2014, of which 173 patients (2.4%) underwent outpatient TSA. The 30-day adverse event rate in the outpatient and inpatient TSA cohorts was 2.31% and 7.89%, respectively. The 30-day readmission rate in the outpatient and inpatient TSA cohorts was 1.74% and 2.93%, respectively. In the multivariate logistic regression, the odds of an adverse event or readmission were not significantly different (odds ratio of 0.4 [$P = .077$] and odds ratio of 0.7 [$P = .623$], respectively).
Conclusion: There are no significant differences in the 30-day adverse event and readmission rates between outpatient and inpatient TSA. In the appropriately selected patient, outpatient TSA is safe and cost-effective.
Level of evidence: Level III; Retrospective Cohort Design; Treatment Study

Keywords: Total shoulder arthroplasty; outpatient; inpatient; adverse events; readmission; population study

This study is exempt from Institutional Review Board approval (anonymous administrative database study not requiring review).

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The rate of total shoulder arthroplasty (TSA) is rising,[11,16,26] which has ramifications for health care expenditure. In an attempt to minimize cost, there has been discussion about decreasing the duration of inpatient hospital stay, including performing TSA as an outpatient procedure. At present, the practice of outpatient TSA has yet to become commonplace for a variety of reasons, of which patient safety is likely to be the primary concern. Furthermore, there are currently no published reports pertaining to the outcomes of this practice. In this study, we used a large population database to identify patients who have undergone TSA as an outpatient procedure, to determine the 30-day adverse event and readmission rates after outpatient TSA, and to compare the 30-day adverse event and readmission rates after outpatient TSA with a cohort of patients who underwent TSA in the traditional inpatient setting.

Materials and methods

We conducted a retrospective cohort study using the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database. The ACS NSQIP collects 323 patient variables from 517 participating hospitals in the United States that are compliant with the Health Insurance Portability and Accountability Act.[28] Patients included in the ACS NSQIP database are prospectively identified, and patient information is collected from operative reports, medical records, and patient interviews by trained clinical reviewers.[17,28] Routine auditing by the program ensures high-quality data, with reported inter-rater disagreement below 2% for all variables. Data are collected through postoperative day 30, including after discharge.

Patients who underwent TSA between 2005 and 2014 were identified in the ACS NSQIP database using the *Current Procedural Terminology* (CPT) code 23472, which includes anatomic TSA and reverse TSA procedures. Revision TSA (CPT code 23332) and hemiarthroplasty (CPT code 23470) procedures were excluded.

Two cohorts were developed by use of length of stay (LOS) data available in the ACS NSQIP database: an outpatient TSA cohort and an inpatient TSA cohort. In the ACS NSQIP database, LOS is defined as the number of calendar days from the procedure until discharge. For this study, patients with an LOS of 0 days (discharged on the same calendar day as the TSA procedure) were considered to have undergone an outpatient TSA, and patients with an LOS of 1 day or greater were considered to have undergone an inpatient TSA.

Patient characteristics collected from the ACS NSQIP database included sex, age, height, weight, and history of smoking. Body mass index (BMI) was calculated from each patient's height and weight. Information about medical comorbidities was also collected from the ACS NSQIP database, with American Society of Anesthesiologists (ASA) class ≥ 3 indicating severe systemic disease. History of pulmonary disease was defined as a history of dyspnea or severe chronic obstructive pulmonary disease. Diabetes was classified as insulin-dependent diabetes mellitus or non–insulin-dependent diabetes mellitus. Functional status was defined as the patient's ability to perform the activities of daily living (ADLs) within the 30 days before surgery, with the patient's best functional status during this period recorded. Similar to the collection of other variables in the ACS NSQIP, this information was obtained through chart abstraction and patient interviews by trained personnel. ADLs are defined in the ACS NSQIP as "the activities usually performed in the course of a normal day in a person's life," including bathing, feeding, dressing, toileting, and mobility. An independent patient is one who does not require assistance for any ADLs, whereas a partially dependent patient requires assistance for some ADLs, and a totally dependent patient requires assistance in completing all ADLs. Partially and totally dependent patients were grouped together for analysis. Anesthesia type was also available in the database and was classified as general or nongeneral for this study. Operative time was defined as the minutes between the opening incision and the end of wound closure, and this was used as a surrogate for case complexity.

The ACS NSQIP tracks patients for individual adverse events occurring within the first 30 postoperative days (including while the patient is in the hospital as well as after discharge). A "serious" adverse event was defined as the occurrence of any of the following: death, coma >24 hours, on ventilator >48 hours, unplanned intubation, stroke/cerebrovascular accident, thromboembolic event (deep venous thrombosis or pulmonary embolism), infectious complication (superficial surgical site infection, deep surgical site infection, organ/space infection, or sepsis), cardiac arrest, myocardial infarction, acute renal failure, return to the operating room, graft/prosthesis/flap failure, or peripheral nerve injury. Similarly, a "minor" adverse event was defined as wound dehiscence, blood transfusion, urinary tract infection, pneumonia, or progressive renal insufficiency. Any adverse event was defined as the occurrence of either a severe or minor adverse event. Readmission was defined as a binary variable that was positive when a patient had an unplanned readmission 1 or more times after the initial postoperative discharge. Readmission data were available only from 2011 onward, and as such, data for patients readmitted between 2005 and 2011 were not available.

Statistical analysis

Statistical analyses were conducted using Stata version 13.1 (StataCorp LP, College Station, TX, USA). Pearson χ^2 test was used to compare age, sex, ASA class, BMI, pulmonary disease, hypertension, smoking status, diabetes, functional status, and anesthesia type of patients who received inpatient TSA vs. outpatient TSA. Student *t*-test was used to compare operative time between these cohorts.

Bivariate and multivariate logistic regressions were subsequently used to compare the rates of adverse outcomes that occurred with inpatient and outpatient TSA, using inpatient TSA cases as the reference. Multivariate regression adjusted for baseline differences in both patient characteristics (age, sex, ASA class, BMI, pulmonary disease, hypertension, smoking status, diabetes, functional status) and procedure characteristics (anesthesia type and operative time). For these regressions, only adverse events with an occurrence in both the inpatient and outpatient cohorts were compared. All tests were 2 tailed, and the statistical difference was established at a 2-sided α level of .05 ($P < .05$).

Results

Overall, we identified 7197 patients who underwent TSA between 2005 and 2014. Among these patients, 173 patients (2.4%) underwent TSA as an outpatient procedure with an LOS of 0 days, and these patients constituted the outpatient

TSA cohort. The remaining 7024 patients (97.6%) underwent primary TSA as an inpatient procedure with a mean LOS of 2.1 ± 1.8 days, and these patients constituted the inpatient TSA cohort. For patients in the outpatient TSA cohort, records dictating discharge disposition were available for 116 patients (67.1%), and all but 4 patients went home. The remaining 4 patients were discharged to either a rehabilitation facility or a skilled nursing home.

As illustrated in Table I, there were significant differences between the outpatient and inpatient TSA cohorts in most patient characteristics. The outpatient TSA cohort was significantly younger, had a significantly higher proportion of male patients, had significantly lower ASA scores, had significantly lower BMI scores, and had significantly lower rates of pulmonary disease and hypertension compared with the inpatient TSA cohort. There were also significant differences in procedure characteristics between the 2 cohorts; a significantly greater proportion of the inpatient TSA cohort received general anesthesia, and operative times in the outpatient TSA cohort were significantly shorter than in the inpatient cohort (Table I).

As illustrated in Table II, we identified 558 adverse events (7.75%) within 30 days of TSA, of which 4 events (2.31%; n = 173) occurred in the outpatient TSA cohort and 554 events (7.89%; n = 7024) occurred in the inpatient TSA cohort. A breakdown of all minor and severe events, stratified by cohort type, is listed in Table II. In the bivariate logistic regression, the odds of any adverse event were significantly less among the outpatient TSA cohort (odds ratio, 0.28; $P = .011$); however, this difference approached but did not reach statistical significance in the multivariate analysis (odds ratio, 0.4; $P = .077$). In addition, the overall and individual odds of a minor or severe adverse event were not significantly different between the outpatient and inpatient TSA cohorts in the multivariate logistic regression (Table III).

Readmission data were available for 6014 TSA patients (83.6% of overall TSA cohort). Of those patients for whom readmission data were available, 175 patients (2.91%; n = 7198) were readmitted to the hospital within 30 days of TSA (Table II). Among the outpatient TSA cohort, 2 patients were readmitted to the hospital within 30 days of TSA (1.74%; n = 115) compared with 173 patients (2.93%; n = 5899) in the inpatient TSA cohort. In the multivariate logistic regression, the odds of readmission were not significantly different between the inpatient and outpatient TSA cohorts (odds ratio, 0.7; $P = .623$). Of those instances in which a readmission diagnosis was listed (n = 76), the most common reasons for readmission across the entire group (outpatient and inpatient TSA cohorts) after TSA were pneumonia (19.4%; n = 14), implant instability (15.8%; n = 12), pulmonary embolism (11.8%; n = 9), deep wound infection (6.6%; n = 5), and hematoma (5.3%; n = 4). No readmission diagnosis was

Table I A comparison of demographic and health status variables between inpatient and outpatient total shoulder arthroplasty cohorts

	All patients	Outpatients	Inpatients	*P*
Overall	7197 (100%)	173 (2.4%)	7024 (97.6%)	
Age				**<.001**
18-64	28.6	53.5	28.0	
65-74	35.5	26.4	38.8	
75-84	28.1	17.8	28.3	
85+	4.8	2.3	4.9	
Male sex	43.5	58.1	43.2	**<.001**
ASA 3+	51.3	34.5	51.7	**<.001**
BMI				**.013**
<25	18.2	21.8	18.1	
30-35	32.9	41.4	32.7	
35-40	25.9	20.7	26.0	
40+	23.0	16.1	23.2	
Pulmonary disease	11.4	6.3	11.5	**.034**
Hypertension	67.3	54.6	67.6	**<.001**
Current smoker	9.9	13.2	9.8	.135
Diabetes				.137
NIDDM	11.6	8.1	11.7	
IDDM	5.0	3.5	5.0	
Dependent functional status	3.4	4.6	3.3	.354
General anesthesia	95.7	91.9	95.8	**.013**
Operative time (minutes), mean + SD	117 + 49	94 + 59	117 + 49	**<.001**

ASA, American Society of Anesthesiologists; *BMI,* body mass index; *NIDDM,* non–insulin-dependent diabetes mellitus; *IDDM,* insulin-dependent diabetes mellitus; *SD,* standard deviation.
Data are presented as percentages unless otherwise indicated.
Bolded values denote statistical significance ($P < .05$).

Table II Rates of adverse events in the patient sample

	Overall		Outpatients		Inpatients	
Event	No.	%	No.	%	No.	%
Any adverse event	558	7.75	4	2.31	554	7.89
Severe adverse event	192	2.67	2	1.16	190	2.71
Death	12	0.02	0	0.00	12	0.17
Coma >24 hours	0	0.00	0	0.00	0	0.00
Ventilator >48 hours	6	0.08	0	0.00	6	0.09
Unplanned intubation	12	0.17	0	0.00	12	0.17
Stroke/cerebrovascular accident	9	0.13	0	0.00	9	0.13
Thromboembolic event (DVT/PE)	44	0.61	1	0.58	43	0.61
Infectious complication	48	0.67	0	0.00	48	0.68
Cardiac arrest requiring CPR	5	0.07	0	0.00	5	0.07
Myocardial infarction	13	0.18	1	0.58	12	0.17
Acute renal failure	3	0.04	0	0.00	3	0.04
Return to the operating room	75	1.04	0	0.00	75	1.07
Graft/prosthesis/flap failure	1	0.01	0	0.00	1	0.01
Peripheral nerve injury	9	0.13	0	0.00	9	0.13
Minor adverse event	409	5.68	3	1.73	406	5.78
Wound dehiscence	6	0.08	0	0.00	6	0.09
Blood transfusion	316	4.39	1	0.58	315	4.48
Urinary tract infection	64	0.89	1	0.58	63	0.90
Pneumonia	36	0.50	1	0.58	35	0.50
Progressive renal insufficiency	7	0.10	0	0.00	7	0.10
Readmission*	175	2.91	2	1.74	173	2.93

DVT, deep venous thrombosis; *PE*, pulmonary embolism; *CPR*, cardiopulmonary resuscitation.
* Readmission data available only from 2011 onward (6014 total patients, 115 [1.91%] of whom underwent outpatient TSA surgery).

available for the 2 patients who were readmitted within 30 days of an outpatient TSA.

Discussion

This is the first study to report on the rate of adverse events and readmission after outpatient TSA compared with inpatient TSA. Overall, we identified 173 patients who had undergone outpatient TSA since 2005, which represents approximately 2.4% of all TSA procedures in the NSQIP population database. When patient characteristics (age, sex, ASA score, BMI, functional status, and a number of comorbid medical conditions) and procedure characteristics (anesthesia type and operative time) are considered in a multivariate logistic regression, there were no significant differences in either the 30-day adverse event rate or the readmission rate of patients undergoing outpatient and inpatient TSA. On the basis of these findings, we believe that in the appropriately selected patient, outpatient TSA is safe with an expected risk

Table III Association of outpatient status with adverse events and readmission in total shoulder arthroplasty patients

	Bivariate logistic regression		Multivariate logistic regression	
	OR (95% CI)	*P*	OR (95% CI)	*P*
Any adverse event	**0.28 (0.10-0.74)**	**.011**	0.40 (0.14-1.10)	.077
Severe adverse event	0.42 (0.10-1.70)	.226	0.51 (0.12-2.09)	.352
Thromboembolic event	0.94 (0.12-6.89)	.955	1.57 (0.21-11.66)	.659
Myocardial infarction	3.39 (0.44-26.27)	.241	4.89 (0.61-39.38)	.136
Minor adverse event	**0.29 (0.09-0.90)**	**.033**	0.46 (0.14-1.46)	.186
Urinary tract infection	0.64 (0.08-4.65)	.662	1.03 (0.14-7.58)	.977
Blood transfusion	**0.12 (0.02-0.88)**	**.038**	0.20 (0.03-1.43)	.109
Pneumonia	1.16 (0.15-8.52)	.883	1.74 (0.22-13.3)	.593
Readmission	0.59 (0.14-2.39)	.456	0.70 (0.17-2.88)	.623

OR, odds ratio; *CI,* confidence interval.
Bolded values denote statistical significance (*P* <.05).

profile comparable to that of inpatient TSA but with the potential benefit of being more cost-effective.

The movement toward outpatient TSA is a reflection of the current health care environment in which cost is a fundamental consideration.[7,25] At present, the most common practice after TSA is an admission to the hospital, with an average duration of stay of 2.2 days in the reported literature[13] and 2.1 days in our specific cohort. Although it is believed that this practice may optimize patient recovery and pain control, it is associated with an average daily cost of U.S. $4000.[6] With interest among policy makers to reduce health care expenditure, an obvious strategy would be to minimize the duration of stay after TSA,[5,19,25] provided there is no deleterious impact on patient safety or outcomes. This practice is not a new concept, as outpatient total knee arthroplasty (TKA) and total hip arthroplasty (THA) have been available for the past decade.[2,4,5,9,15,18] Before the implementation of outpatient TKA and THA, similar concerns existed about the possibility of compromising patient safety to optimize health care expenditure.[4] Despite these concerns, published reports have suggested that in appropriately selected patients, the risks of a complication or readmission are not increased after outpatient lower extremity arthroplasty procedures.[2,18] Similarly, we observed that patient safety was not compromised after outpatient TSA.

One common theme pertaining to outpatient total joint arthroplasty is that patient selection is paramount. In published reports pertaining to outpatient TKA and THA, there is a trend toward performing these procedures in younger, male patients with limited medical comorbidities and a social support network that can assist with the early recovery period.[2,4,5,9,15,18] In this study, we also found that there was a bias toward performing outpatient TSA in younger, healthier men. Interestingly, this bias has emerged in the absence of any published evidence to suggest that these patients are better suited specifically for outpatient TSA, but it is a reasonable assumption based on literature that correlates older patient age, female sex, and greater comorbidity to increased LOS after TSA.[13,21,22] Given the emphasis placed on patient selection and safety, we strongly believe that an important next step would be to identify risk factors for adverse events and readmission after outpatient TSA, improving patient selection as has been done for outpatient THA and TKA.[8,27] Ultimately, this will be fundamental to the successful implementation of any outpatient TSA program, as clinicians will be better equipped not only to appropriately select patients for outpatient TSA but also to counsel them about risk in the perioperative period.

In this study, we determined the adverse event and readmission rates during the immediate postoperative period (30 days). Given that this movement toward outpatient TSA reflects a trend toward minimizing health care costs, an increase in either the adverse event or readmission rate would result in an increased utilization of health care resources, which may nullify differences in cost attributed solely to the immediate postoperative admission.[30] Although it initially appeared that patients undergoing inpatient TSA had a higher rate of adverse events within 30 days compared with patients undergoing outpatient TSA, this difference did not reach statistical significance when the 2 cohorts were matched according to patient and procedure characteristics. Similarly, we did not find a statistically significant difference in adverse events when stratified by severe or minor events or in readmission rates between inpatient and outpatient TSA. Looking closer at the data, the initial differences in the bivariate analysis likely reflect the fact that across the entire cohort, patients who underwent inpatient TSA were significantly older and had significantly more comorbid medical conditions, which in and of themselves are known risk factors for complications after TSA.[10,29] In addition, we also found that a significantly greater proportion of patients who underwent inpatient TSA received general anesthesia, which may also contribute to an increase in postoperative adverse events and need for admission.[12] Although we do acknowledge that a limitation of this analysis is the small size of the outpatient TSA cohort compared with the inpatient TSA cohort, one must also consider that patients admitted to the hospital after TSA may be more likely to have a workup for or to be diagnosed with an adverse event, given their continuous monitoring and frequent interaction with health care professionals.

Given the nature of the database used in this study, a national trend in the utilization of outpatient TSA could not be calculated; however, we believe that given the observed increase in outpatient TKA and THA, there will be a similar interest among providers and policy makers to push toward the implementation of outpatient TSA programs. It is encouraging that outpatient TKA and THA programs have had success, particularly given our belief that TSA may be more suitable for the outpatient setting. First, the shoulder is a non–weight-bearing joint that can be readily immobilized in a sling to improve pain control. Second, the shoulder and upper extremity are amendable to continuous regional blockade, which can improve pain control in the immediate postoperative period. Third, the rates of significant medical adverse events, such as blood loss and requirement for transfusion[1,14] and pulmonary embolism,[20,23] appear to be less after TSA compared with TKA and THA, and for this reason, patients undergoing TSA may require less continuous postoperative treatment and monitoring. Overall, we believe that outpatient TSA will have success similar to that of outpatient TKA and THA programs, and moving forward, there should be emphasis on leveraging the experiences of clinicians performing outpatient TKA and THA to develop similar protocols for clinicians with interest in outpatient TSA.[2,27]

As with any study using a population database, there are limitations reflecting that specific database. First, the NSQIP database is not nationally representative, and so our findings do not reflect practice across the United States. In addition, the NSQIP database is heavily weighted toward hospitals, and our findings likely underestimate the scope of outpatient TSA across the United States. Second, the duration of follow-up is limited to 30 days, so adverse events and readmissions beyond that postoperative period were not captured; however, evidence pertaining to TKA and THA suggests that 90% of all major medical complications arise within the first 4 days after the procedure,[24] and as such, we believe that 30 days is a reasonable period in which to capture the majority of postoperative adverse events and readmissions that would be related to the site of surgery and duration of postoperative stay. Another important consideration would be presentation to the emergency department or general practitioner without readmission to the hospital, as this could also increase the outpatient TSA cost; however, these data were not available in the database used. Third, we could not identify patients who were initially targeted for outpatient TSA but were not discharged accordingly and required an admission to the hospital. This is an important consideration, as past studies have suggested that up to 6% of patients undergoing outpatient TKA required an admission to the hospital secondary to inadequate pain control.[3] On the other hand, we also observed that several patients classified as "outpatient" were not discharged home but were discharged to a rehabilitation facility or specialized nursing facility. Given that this information was available for only two-thirds of the outpatient TSA cohort (67.1%), we could not reliably use discharge disposition as an inclusion/exclusion criterion, and we recognize that although it is small, there may be some heterogeneity in the outpatient TSA cohort. Fourth, the NSQIP database does not collect cost data, and any statement pertaining to cost of care would be an estimation using reported cost averages, which may overestimate or underestimate the true health care expenditure. Given that we have demonstrated outpatient TSA to be safe in the appropriately selected patient, there is now a need to demonstrate the potential cost savings and impact on health care expenditure. Fifth, the database precluded us from determining if any perioperative medical optimization or treatment was undertaken before patients underwent outpatient TSA. This is an important consideration and has been fundamental to the success of outpatient lower extremity arthroplasty.[2,27] Sixth, we could not identify specific postoperative management protocols for patients undergoing outpatient TSA, including postoperative pain control. We do acknowledge that this will be an important consideration for providers looking to adopt an outpatient TSA practice, and going forward, clinical studies should focus on the development of postoperative protocols that optimize patient comfort and safety after outpatient TSA. Future research efforts should be focused on outlining a clear postoperative protocol that optimizes patient safety in the outpatient TSA setting. Seventh, we could not determine preoperative disease severity, which may influence the complexity of the arthroplasty case and, potentially, risk for adverse events. Despite this limitation, we thought that operative time was a reasonable surrogate for case complexity, and this was accounted for in the multivariate regression analysis. Eighth, although we reported readmission data for our outpatient and inpatient TSA cohorts, data pertaining to patients readmitted before 2011 were not available. As such, data pertaining to 16.4% of the entire study cohort were not available, and it is unknown what the influence of these data could have had on the study findings and conclusions. In addition, there were instances in which the readmission diagnosis was not listed, and this is the reason that we could not identify a readmission diagnosis for the 2 patients readmitted after outpatient TSA. Last, the NSQIP database does not report patient-reported outcomes, which was beyond the scope and intent of this study.

Aside from limitations specific to the database, we also recognize that there is an important limitation that is specific to this study methodology: defining outpatient status. In this particular study, we chose to include only patients who were discharged from the hospital on the same calendar day as their TSA procedure. We do recognize that this excludes patients who were "fast-tracked" and discharged within 23 hours of the TSA procedure (first postoperative morning). Although the latter may be more common presently, the rationale for establishing our particular cutoff was to create a strict definition of outpatient surgery for which no overnight stay is required.

Conclusions

Using a population database of providers in the United States, we have demonstrated that in the appropriately selected patient, outpatient TSA is safe. Furthermore, when patient and procedure characteristics are considered, there is no significant difference in adverse event risk and readmission rates of patients undergoing TSA in either the outpatient or inpatient setting. Going forward, there is a need to identify those patients best suited for outpatient TSA, to develop perioperative protocols that minimize adverse events and maximize patient comfort after outpatient TSA, and to identify risk factors for readmission after outpatient TSA.

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References

1. Anthony CA, Westermann RW, Gao Y, Pugely AJ, Wolf BR, Hettrich CM. What are risk factors for 30-day morbidity and transfusion in total shoulder arthroplasty? A review of 1922 cases. Clin Orthop Relat Res 2015;473:2099-105. http://dx.doi.org/10.1007/s11999-014-4107-7
2. Aynardi M, Post Z, Ong A, Orozco F, Sukin DC. Outpatient surgery as a means of cost reduction in total hip arthroplasty: a case-control study. HSS J 2014;10:252-5. http://dx.doi.org/10.1007/s11420-014-9401-0
3. Berger RA, Kusuma SK, Sanders SA, Thill ES, Sporer SM. The feasibility and perioperative complications of outpatient knee arthroplasty. Clin Orthop Relat Res 2009;467:1443-9. http://dx.doi.org/10.1007/s11999-009-0736-7
4. Berger RA, Sanders SA, Thill ES, Sporer SM, Della Valle C. Newer anesthesia and rehabilitation protocols enable outpatient hip replacement in selected patients. Clin Orthop Relat Res 2009;467:1424-30. http://dx.doi.org/10.1007/s11999-009-0741-x
5. Bertin KC. Minimally invasive outpatient total hip arthroplasty: a financial analysis. Clin Orthop Relat Res 2005;154-63.
6. Bohl DD, Samuel AM, Basques BA, Della Valle CJ, Levine BR, Grauer JN. How much do adverse event rates differ between primary and revision total joint arthroplasty? J Arthroplasty 2016;31:596-602. http://dx.doi.org/10.1016/j.arth.2015.09.033
7. Bozic KJ, Ward L, Vail TP, Maze M. Bundled payments in total joint arthroplasty: targeting opportunities for quality improvement and cost reduction. Clin Orthop Relat Res 2014;472:188-93. http://dx.doi.org/10.1007/s11999-013-3034-3
8. Courtney PM, Rozell JC, Melnic CM, Lee GC. Who should not undergo short stay hip and knee arthroplasty? Risk factors associated with major medical complications following primary total joint arthroplasty. J Arthroplasty 2015;30:1-4. http://dx.doi.org/10.1016/j.arth.2015.01.056
9. Cross MB, Berger R. Feasibility and safety of performing outpatient unicompartmental knee arthroplasty. Int Orthop 2014;38:443-7. http://dx.doi.org/10.1007/s00264-013-2214-9
10. Cvetanovich GL, Schairer WW, Haughom BD, Nicholson GP, Romeo AA. Does resident involvement have an impact on postoperative complications after total shoulder arthroplasty? An analysis of 1382 cases. J Shoulder Elbow Surg 2015;24:1567-73. http://dx.doi.org/10.1016/j.jse.2015.03.023
11. Day JS, Lau E, Ong KL, Williams GR, Ramsey ML, Kurtz SM. Prevalence and projections of total shoulder and elbow arthroplasty in the United States to 2015. J Shoulder Elbow Surg 2010;19:1115-20. http://dx.doi.org/10.1016/j.jse.2010.02.009
12. D'Alessio JG, Rosenblum M, Shea KP, Freitas DG. A retrospective comparison of interscalene block and general anesthesia for ambulatory surgery shoulder arthroscopy. Reg Anesth 1995;20:62-8.
13. Dunn JC, Lanzi J, Kusnezov N, Bader J, Waterman BR, Belmont PJ. Predictors of length of stay after elective total shoulder arthroplasty in the United States. J Shoulder Elbow Surg 2015;24:754-9. http://dx.doi.org/10.1016/j.jse.2014.11.042
14. Gillespie R, Shishani Y, Joseph S, Streit JJ, Gobezie R. Neer Award 2015: a randomized, prospective evaluation on the effectiveness of tranexamic acid in reducing blood loss after total shoulder arthroplasty. J Shoulder Elbow Surg 2015;24:1679-84. http://dx.doi.org/10.1016/j.jse.2015.07.029
15. Hartog YM, Mathijssen NM, Vehmeijer SB. Total hip arthroplasty in an outpatient setting in 27 selected patients. Acta Orthop 2015;86:667-70. http://dx.doi.org/10.3109/17453674.2015.1066211
16. Jain NB, Higgins LD, Guller U, Pietrobon R, Katz JN. Trends in the epidemiology of total shoulder arthroplasty in the United States from 1990-2000. Arthritis Rheum 2006;55:591-7. http://dx.doi.org/10.1002/art.22102
17. Khuri SF, Henderson WG, Daley J, Jonasson O, Jones RS, Campbell DA Jr, et al. Successful implementation of the Department of Veterans Affairs' National Surgical Quality Improvement Program in the private sector: the Patient Safety in Surgery study. Ann Surg 2008;248:329-36.
18. Kort NP, Bemelmans YF, Schotanus MG. Outpatient surgery for unicompartmental knee arthroplasty is effective and safe. Knee Surg Sports Traumatol Arthrosc 2015 Jul 1; [Epub ahead of print]. http://dx.doi.org/10.1007/s00167-015-3680-y.
19. Lovald ST, Ong KL, Malkani AL, Lau EC, Schmier JK, Kurtz SM, et al. Complications, mortality, and costs for outpatient and short-stay total knee arthroplasty patients in comparison to standard-stay patients. J Arthroplasty 2014;29:510-5. http://dx.doi.org/10.1016/j.arth.2013.07.020
20. Lyman S, Sherman S, Carter TI, Bach PB, Mandl LA, Marx RG. Prevalence and risk factors for symptomatic thromboembolic events after shoulder arthroplasty. Clin Orthop Relat Res 2006;448:152-6.
21. Matsen FA, Li N, Gao H, Yuan S, Russ SM, Sampson PD. Factors affecting length of stay, readmission, and revision after shoulder arthroplasty: a population-based study. J Bone Joint Surg Am 2015;97:1255-63. http://dx.doi.org/10.2106/JBJS.N.01107
22. Menendez ME, Baker DK, Fryberger CT, Ponce BA. Predictors of extended length of stay after elective shoulder arthroplasty. J Shoulder Elbow Surg 2015;24:1527-33. http://dx.doi.org/10.1016/j.jse.2015.02.014
23. Navarro RA, Inacio MC, Burke MF, Costouros JG, Yian EH. Risk of thromboembolism in shoulder arthroplasty: effect of implant type and traumatic indication. Clin Orthop Relat Res 2013;471:1576-81. http://dx.doi.org/10.1007/s11999-013-2829-6
24. Parvizi J, Mui A, Purtill JJ, Sharkey PF, Hozack WJ, Rothman RH. Total joint arthroplasty: When do fatal or near-fatal complications occur? J Bone Joint Surg Am 2007;89:27-32. http://dx.doi.org/10.2106/JBJS.E.01443
25. Rana AJ, Bozic KJ. Bundled payments in orthopaedics. Clin Orthop Relat Res 2015;473:422-5. http://dx.doi.org/10.1007/s11999-014-3520-2
26. Singh JA, Ramachandran R. Age-related differences in the use of total shoulder arthroplasty over time: use and outcomes. Bone Joint J 2015;97-B:1385-9. http://dx.doi.org/10.1302/0301-620X.97B10.35696
27. Thienpont E, Lavand'homme P, Kehlet H. The constraints on day-case total knee arthroplasty: the fastest fast track. Bone Joint J 2015;97-B:40-4. http://dx.doi.org/10.1302/0301-620X.97B10.36610
28. User Guide for the 2012 ACS NSQIP Participant Use Data File. Available at: <https://www.facs.org/quality-programs/acs-nsqip/program-specifics/participant-use>; 2013.
29. Waterman BR, Dunn JC, Bader J, Urrea L, Schoenfeld AJ, Belmont PJ. Thirty-day morbidity and mortality after elective total shoulder arthroplasty: patient-based and surgical risk factors. J Shoulder Elbow Surg 2015;24:24-30. http://dx.doi.org/10.1016/j.jse.2014.05.016
30. Yu S, Garvin KL, Healy WL, Pellegrini VD, Iorio R. Preventing hospital readmissions and limiting the complications associated with total joint arthroplasty. J Am Acad Orthop Surg 2015;23:e60-71. http://dx.doi.org/10.5435/JAAOS-D-15-00044