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Original Research

Outcomes and Cost Analysis of a Surgical Care Unit for Outpatient Total Joint Arthroplasties Performed at a Tertiary Academic Center

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ABSTRACT

Background: Total joint arthroplasty (TJA) has shifted toward being an outpatient surgery with advances in perioperative protocols and patient selection. Most literature on outpatient arthroplasty focuses on the surgery performed in ambulatory centers. This study sought to compare (1) short-term outcomes and (2) the total procedural cost in patients who underwent TJAs at a tertiary academic center and were discharged from the accelerated surgical care unit (SCU) vs the inpatient floor unit.
Methods: This is a retrospective review of 1231 procedures (637 total knee arthroplasties and 594 total hip arthroplasties) performed between January 2020 and May 2021 at 1 tertiary academic center. The minimum required follow-up duration was 90 days. Patients were divided into 2 cohorts based on discharge location (SCU vs inpatient). Patient demographics, medical comorbidities, 90-day hospital returns, and revisions were evaluated with univariate and multivariate analyses. Of the 1231 patients, 1092 had available cost data that were analyzed by a univariate analysis.
Results: Patients discharged from the SCU were younger ($P < .01$), with lower American Society of Anesthesiologists scores ($P = .04$). SCU patients trended toward fewer 90-day hospital returns and revisions; however, these results were not significant. The overall encounter cost for TJA was significantly lower in patients discharged from the SCU ($P < .01$). Cost remained significantly less at 30 and 90 days postoperatively ($P < .01$).
Conclusions: The present study represents the current activity at many large tertiary American academic medical centers. Results demonstrate that a unit for accelerated discharge after TJAs in a tertiary academic center is safe and cost-effective. With proper implementation, its development will enhance arthroplasty programs at a large tertiary academic center.

Introduction

Total joint arthroplasty (TJA) has seen a shift toward being an outpatient surgery with advances in perioperative protocols and patient selection. It is predicted that greater than half of all primary joint arthroplasties will be performed in an outpatient setting by the year 2026 [1]. With continued growth in TJAs performed annually, the Bundled Payment Care Initiative was instituted by the Center for Medicare and Medicaid Services in 2013 to decrease costs associated with TJAs [2,3]. This initiative restructured the hospital reimbursement model for TJAs and placed a greater emphasis on value-based care. Hospital systems and orthopedic institutions responded to this change by implementing clinical care pathways geared toward reducing hospital length of stay (LOS) and overall cost of care [4–9]. These pathways have proved successful while maintaining patients' safety as well as clinical and patient-reported outcomes. As a result of this success, hospital systems have developed short-stay pathways for outpatient or same-day discharge after TJAs [9,10].

Within the established clinical care pathways, outpatient TJAs can be performed in both a hospital outpatient unit or an ambulatory surgery center (ASC). There are many differences between

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hospital and ASC models, including staffing, financial pressure, and time pressure on the arthroplasty surgeon [11]. The efficiency of an ASC provides the potential for significant cost reduction when compared to hospital-based procedures [11,12]. Thus, the transition to outpatient surgery at ASCs has historically been more feasible [11]. Today, most published data on outpatient arthroplasty programs focus on those performed in ASCs or orthopedic specialty hospitals. There are limited reports on implementation of an outpatient program at a large tertiary academic center where these transitions are typically more challenging.

Despite promising early results with high patient satisfaction after outpatient TJAs, there are limited data on early postoperative results and cost analysis of outpatient TJAs performed in a large academic center [4,9,11–14]. The COVID-19 pandemic accelerated the need for optimization of postoperative care with rapid recovery and early discharge after a surgery. At the time of this study, there was no access to a freestanding ASC for outpatient TJAs at the investigating institution. Thus, the institution adopted a postoperative surgical care unit (SCU) for accelerated discharge after TJAs. With this development, the 2 goals of this study were as follows: to compare (1) short-term outcomes including 90-day hospital returns and reoperations and (2) the total procedural cost in patients who underwent TJAs at a tertiary academic center and were discharged from the SCU vs the inpatient orthopedic floor. The authors hypothesized that patients discharged from the SCU would have comparable short-term outcomes, with a lower cost for service than patients in the standard inpatient pathway.

Material and methods

This is an institutional review board–approved, retrospective cohort study conducted from January 1, 2020, to May 1, 2021, at a tertiary academic center. Patients evaluated underwent a primary total knee arthroplasty (TKA) or a total hip arthroplasty (THA) in the above timeframe and were discharged from either the SCU or inpatient floor. Patients undergoing revision TJAs and those discharged from a location other than the SCU or inpatient floor were excluded. The minimum required follow-up duration for inclusion was 90 days.

The SCU is a hospital unit implemented to facilitate accelerated patient discharge after a surgery. It is appropriate for intermediate- and step-down-level surgical care with a nurse-to-patient ratio between 1:3 and 1:4. The decision to send a patient to the SCU was at the discretion of the surgeons and based on patient factors such as age and general health that led the surgeon to believe they could be discharged by postoperative day one. This decision was made by the surgeon preoperatively and re-evaluated on the day of surgery. There were no strict criteria that led to patient discharge disposition to the SCU vs the inpatient floor. Patients admitted to the SCU were not enrolled in a preoperative optimization "fast-track" program, and the location of postoperative recovery was determined on the day of surgery. In the SCU, patients were evaluated on the day of surgery by the physical therapy (PT) team. Once medically stable and cleared by the PT, the patient was eligible to be discharged home. Discharge from the SCU occurs on the day of surgery, or on postoperative day one. Patients who required resource-intensive or multidisciplinary care were not appropriate for SCU discharge and were sent to the inpatient floor. All patients were preoperatively classified for outpatient surgery regardless of discharge destination. Patients who stayed at the hospital longer than "2 midnights" were transitioned to inpatient status per institution policy.

At the investigating institution, all patients undergoing TJAs had neuraxial anesthesia and light intravenous (IV) sedation intraoperatively unless contraindicated. Two grams of IV tranexamic acid, one preoperatively and one at closing, is prescribed unless contraindicated. Two grams of Ancef (Pfizer, New York, NY) is given prior to skin incision unless a specific allergy is documented. Patients receive an additional 2 grams every 8 hours for 24 hours unless discharged prior to this. Patients are given IV Decadron (Pfizer, New York, NY) intraoperatively at the surgeon's discretion. Postoperatively, patients undergoing TKAs receive a Breg Polar Care (Breg Company, Carlsbad, CA). Patients undergoing THAs have hip precautions prescribed at the surgeon's discretion. All patients are prescribed a multimodal pain regimen postoperatively.

The electronic health record was initially queried for THA (Current Procedural Terminology code 27130) and TKA (Current Procedural Terminology code 27447) to identify patients who underwent TJAs and were discharged from either the SCU or the inpatient floor. This resulted in 1231 TJA procedures (781 TKA, 450 THA). Demographics, including age, sex, body mass index (BMI), and American Society of Anesthesiologists (ASA) score, were collected from the electronic health record. Short-term outcomes, including LOS, 90-day emergency department (ED) visits, 90-day readmissions, and 90-day revisions, were also recorded.

Patients were divided into 2 cohorts, those discharged from the SCU and those discharged from the inpatient floor. Demographics and short-term outcomes from each cohort were initially compared by a univariate analysis. Statistical methods included t-tests for continuous variables and chi-squared tests for categorical variables. Results are reported as mean and standard deviation. An adjusted, multivariate logistic regression analysis was then performed to identify predictors of 90-day complications. Model covariates included age, gender, BMI, ASA class, discharge location, and total length of hospital encounter. Finally, the 2 cohorts were further stratified by procedure (THA and TKA). A subgroup univariate analysis comparing demographics and short-term outcomes was performed.

The total cost at the time of encounter, 30 and 90 days postoperatively, was collected from an internal accounting database (EPSi). Of the 1231 patients in the study, a total of 1092 (547 SCU, 545 inpatient) had data collected from EPSi. EPSi prospectively tracks expenses at various phases of care throughout the hospital encounter (surgical, radiology, respiratory, pharmacy, intensive care services, cardiology, physical and occupational therapy, laboratory, transfusion, medical surgical supplies, and other direct costs). The time of encounter was defined as the time a patient was admitted to the inpatient hospital floor or SCU until the time they were discharged. All costs accrued during this period were recorded. The 30-day cost was defined as the cost accrued from the time of admission until 30 days postoperatively. The 90-day cost was defined as the cost accrued from the time of admission until 90 days postoperatively. Cohorts were stratified based on the location of discharge (SCU vs inpatient). Costs at the specified time-points for the SCU and inpatient cohorts were then compared by a univariate analysis. A statistical analysis for cost data was performed with a Kruskal-Wallis test, and results are reported as median and interquartile range. Cohorts were again further stratified by procedure, and a subgroup analysis comparing the cost for THA and TKA alone based on the discharge location was also completed.

All statistical analyses were carried out in RStudio v3.6.1. (R Foundation, Vienna, Austria). Data are presented with 95% confidence intervals, and in all cases, statistical significance was set at $P \leq .05$.

Results

Demographics

During the study period, 1231 TJA procedures (781 TKA, 450 THA) were performed. Of the 1231, 637 (52%) patients were discharged from the SCU, and 594 (48%) were discharged from the

Table 1
Patient demographics.

Demographics	Overall (n = 1231)	SCU (n = 637)	Inpatient (n = 594)	*P*-value
Age (y) (SD)	66.7 (10.3)	65.1 (9.6)	68.4 (10.7)	**<.01**
BMI (SD)	30.8 (5.6)	30.8 (5.4)	30.8 (5.7)	.82
ASA score (SD)	2.4 (0.5)	2.4 (0.5)	2.5 (0.5)	**.04**
Length of stay (SD)	1.7 (1.4)	1.2 (0.5)	2.1 (1.7)	**<.01**

Bold values indicate statistical significance.

inpatient floor. The overall mean age was 66.7 years, and 47% of the cohort was male. Patients discharged from the SCU were significantly younger (65.1 vs 70.0 years, $P < .01$) and had a lower ASA score (2.4 vs 2.5, $P = .04$). There were no significant differences in sex or BMI between the 2 cohorts. LOS was significantly shorter for SCU patients (mean 1.2 days [range, 0-2] vs 2.1 days [range, 1-9]) ($P < .01$) (Table 1). Of the patients admitted to the SCU postoperatively, 369 (57.9%) were discharged on the day of surgery. Nineteen patients (2.9%) failed to discharge from the SCU and were sent to the inpatient floor. Reasons for failure to discharge from the SCU included the inability to clear PT, pain control, and necessary postoperative medical optimization prior to discharge. The subgroup analysis demonstrated both THA and TKA patients discharged from the SCU were significantly younger and had a shorter hospital LOS. However, there was no significant difference in ASA class (Table 2).

Ninety-day outcomes

Patients discharged from the SCU trended toward fewer 90-day ED visits (29 [5.3%] vs 39 [7.2%], $P = .25$), readmissions (14 [2.6%] vs 18 [3.3%], $P = .58$), and revisions (1 [0.2%] vs 4 [0.7%], $P = .37$); however, these results were not significant (Table 3). Adjusted logistic regression demonstrated only total length of hospital encounter was a predictor for a 90-day complication ($P = .02$) (Fig. 1). The subgroup analysis demonstrated both TKA and THA patients discharged from the SCU had comparable 90-day complication rates to patients discharged from the inpatient floor (Table 4).

Cost analysis

The overall encounter cost for TJAs was significantly lower in patients who were discharged from the SCU than that for those discharged from the inpatient floor (8869.00 vs 9870.00 [$P < .01$]). The cost remained significantly less at 30 and 90 days postoperatively ($P < .01$) (Fig. 2). A subgroup analysis stratified by procedure was performed and demonstrated that both THA and TKA had significantly lower encounter costs when patients were discharged from the SCU than from the inpatient floor ($P < .01$). This was maintained through 30- and 90-day follow-up ($P < .01$) (Table 5). TKAs with discharge from the inpatient floor incurred the highest expense with a 90-day cost of 10,065.00 dollars, while THAs with discharge from the SCU had the lowest expense at 90 days with a cost of 8843.50 dollars.

Table 3
Acute postoperative outcomes.

Outcomes	Overall (n = 1231)	SCU (n = 637)	Inpatient (n = 594)	*P* value
90-D ED visit (%)	70 (5.7)	30 (4.7)	40 (6.7)	.16
90-D readmission (%)	34 (2.8)	15 (2.4)	19 (3.2)	.47
90-D reoperation (%)	6 (0.5)	1 (0.2)	5 (0.8)	.19

Discussion

Outpatient TJAs are increasing in the United States, with many recent studies demonstrating that it can be a successful and safe option with high patient satisfaction and low complication rates [15,16]. ASCs have traditionally been used to perform outpatient TJAs, and the success of the procedure in this setting is well documented [13–15]. However, there are limited data in the literature on the outcomes and cost-effectiveness of outpatient TJAs performed at a tertiary academic medical center. The authors sought to compare early postoperative outcomes and analyze differences in cost between patients discharged from an outpatient SCU at an academic center and those discharged from the traditional inpatient unit.

Courtney et al. [16] reviewed 169,406 patients from the American College of Surgeons-National Surgical Quality Improvement Program database who underwent a TJA (1220 outpatient). In their study, the outpatient and inpatient groups had an overall complication rate of 8% and 16%, respectively. Outpatient TJAs alone did not increase the risk of readmission and was a negative independent risk factor for complications. This study did not comment on the location of the procedures, however, and as it is a database study, the authors could not comment on the postoperative protocol used for the 2 cohorts. Springer et al. [17] performed a study at 1 medical center that was previously used for inpatient TJAs. The authors compared 137 patients undergoing an outpatient TJA to 106 undergoing a traditional inpatient TJA. Outpatient TJAs trended toward a higher readmission rate; however, the difference between the two was not significant. Xu et al. [18] completed a meta-analysis of 7 included studies reviewing 176,179 inpatient TJAs and 1613 outpatient TJAs. The outpatient and inpatient TJA cohorts had a similar mean age and BMI. The authors found no significant difference in total complications, major complications, or readmissions between the 2 cohorts. Finally, Leroux et al. [19] completed the largest known study of matched cohorts who had a short (less than or equal to 2 days) vs long stay after a TJA. They demonstrated no difference in outcomes, suggesting that a short hospital stay with subsequent discharge home in the appropriately selected patient is safe following THAs or TKAs.

Cost-effectiveness for outpatient THAs and TKAs has been well-documented in the literature [20–22]. Aynardi et al. [21] reviewed

Table 2
Patient demographics stratified by the procedure performed and discharge location.

Demographics	Total hip arthroplasty (n = 450)				Total knee arthroplasty (n = 731)			
	Overall	SCU	Inpatient	*P* value	Overall	SCU	Inpatient	*P* value
Age (y)	65.1	62.6	67.2	**<.01**	67.8	66.4	69.4	**<.01**
BMI	29.7	29.5	30.0	.31	31.3	31.4	31.2	.62
ASA score	2.4	2.4	2.5	.12	2.5	2.4	2.4	.14
Length of stay	1.7	1.2	2.1	**<.01**	1.6	1.1	2.1	**<.01**

Significant *P*-values are bolded.

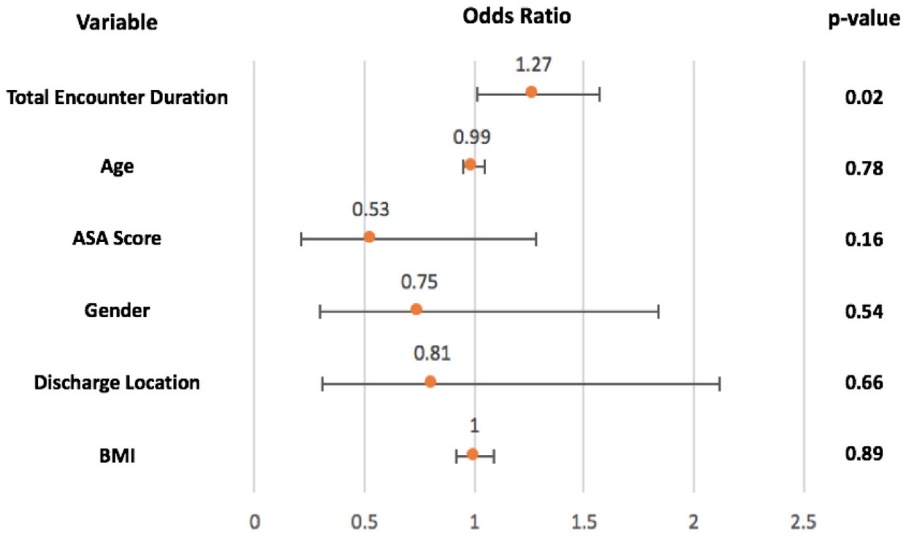

Figure 1. Adjusted multivariate logistic regression analysis for risk factors of 90-day complications.

197 THAs, with 119 outpatient and 78 inpatient procedures. The outpatient procedures were performed at an ASC, while the inpatient procedures were performed in a hospital setting. Their results demonstrated the average final bill charged to the patient or third-party payer in the outpatient setting was significantly lower than that in the inpatient setting, $24,529 vs $31,327. Similarly, studies have demonstrated that an outpatient TKA is more cost-effective than an inpatient surgery [21]. Huang et al. [22] completed a prospective, case-controlled study comparing inpatient and outpatient TKAs performed from the same tertiary academic center. The authors demonstrated that for every case-control match, the outpatient TKA procedure was less costly than the inpatient procedure and yielded a 30% median cost saving. Interestingly, their work is similar to the present study as outpatient procedures were performed in a tertiary academic center. However, these data come from the Canadian health system, which has significantly different payment structures when compared to that of the United States.

The present study represents the current activity of arthroplasty surgeons at many large, tertiary academic medical centers in the United States. To the authors knowledge, it is the largest of the series of its kind. The results demonstrate that implementation of a unit geared toward accelerated discharge after TJAs in a tertiary academic center can yield equivalent short-term outcomes with a shorter LOS and decreased encounter cost. It is well described in the literature that patients with accelerated discharge are often healthier, with fewer comorbidities, and this may contribute to improved postoperative results [16,18,23–25]. In the present study, patients discharged from the SCU did have a lower mean age and ASA score. However, other demographic measures including gender and BMI were equivalent between the 2 groups. In addition, when stratified by the procedure performed, the mean ASA score of patients undergoing THAs and TKAs was not significantly different based on the discharge location. A subgroup analysis demonstrated patients undergoing either THA or TKA in the SCU cohort trended toward improved short-term outcomes in the form of 90-day hospital returns and revisions. Finally, a regression analysis for all TJA procedures demonstrated that when controlling for gender, BMI, age, and ASA score, discharge location was not an independent predictor for 90-day complications, while the length of hospital encounter was an independent predictor for 90-day complications. This study also demonstrated a cost-benefit to outpatient TJAs performed at an academic center. Even when stratified by the procedure performed, patients discharged from the SCU had significantly lower cost than those admitted to an inpatient service. Thus, the authors believe the implementation of a program for accelerated discharge after TJAs at a tertiary academic center is feasible, safe, and cost-saving for both the patient and the hospital system.

Gibon et al. [11] compared patients undergoing an outpatient TKA in a hospital outpatient department to those undergoing a TKA in a traditional inpatient setting. They demonstrated that the hospital outpatient department was both more cost-effective and time-efficient than the traditional inpatient setting. This study is similar to the present research, as it includes outpatient surgeries performed at a hospital and not a stand-alone ASC. There are known differences between hospital and ASC models for outpatient arthroplasties that make the transition to outpatient surgery at an ASC more feasible [11,12]. Gibon et al. [11] hypothesized that staff, nurses, and physical therapists are more prepared and organized for orthopedic outpatient surgeries in an ambulatory site. This cultural difference is in stark contrast to an inpatient environment in which the perioperative team may not be fully aligned with outpatient pathways. However, their results complement those in the present study and demonstrate that outpatient surgeries at a tertiary academic center are not only feasible but also efficient and cost-effective when compared to traditional inpatient surgeries.

Table 4
Acute postoperative outcomes stratified by the procedure performed and discharge location.

90-day complications	Total hip arthroplasty (n = 450)				Total knee arthroplasty (n = 731)			
	Overall	SCU	Inpatient	*P* value	Overall	SCU	Inpatient	*P* value
90-D ED visit (%)	24 (5.5)	9 (4.5)	15 (6.3)	.52	46 (5.9)	21 (4.9)	25 (7.1)	.24
90-D readmission (%)	13 (3.0)	5 (2.5)	8 (3.4)	.79	21 (2.7)	10 (2.3)	11 (3.1)	.64
90-D reoperation (%)	3 (0.7)	0 (0.0)	3 (1.3)	.31	3 (0.4)	1 (0.2)	2 (0.6)	.86

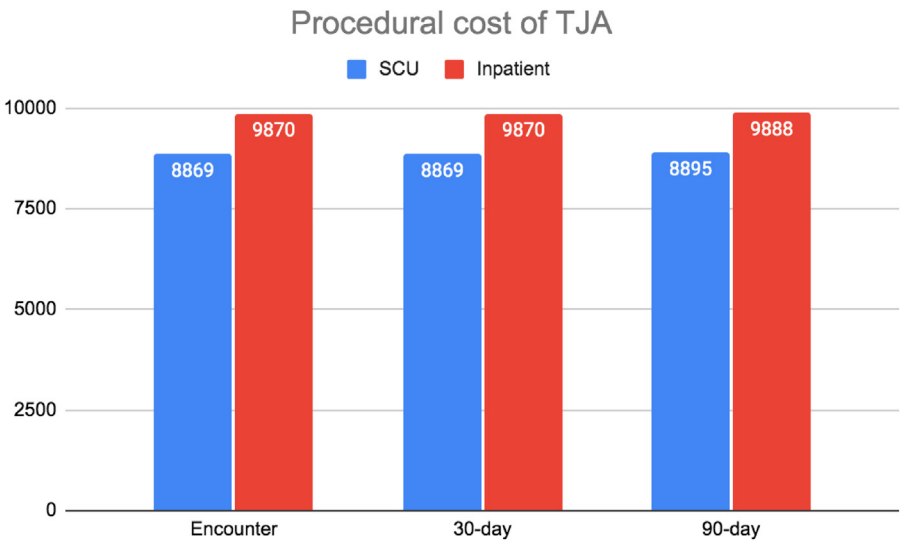

Figure 2. Cost (in dollars) of total joint arthroplasty at initial encounter, postoperative day 30, and postoperative day 90 in patients discharged from the SCU vs inpatient floor.

There are several limitations to this study. This was a retrospective review of each cohort and comes with the inherent disadvantages of this study design and possibility of missed early complications. However, all patients were followed up according to a standardized institutional protocol, and it can be assumed that missed complications would have occurred at similar rates across the groups. In addition, discharge disposition to the SCU vs the inpatient floor was at the discretion of the surgeons, which can lead to a selection bias. Patients discharged from the SCU were younger and had lower ASA scores. They trended toward fewer ED visits, readmissions, and reoperations at both 30 and 90 days postoperatively. This could certainly explain the cost discrepancies between the 2 cohorts, as ED visits, readmissions, and reoperations were all captured in the cost database. While the selection process for SCU patients does introduce a bias in the 2 cohorts, it is no different than selecting patients for outpatient TJAs performed at an ASC. Furthermore, even though patients within the 2 cohorts were not matched to one another during cohort selection, an adjusted, multivariable regression analysis controlling for covariates such as age, gender, BMI, and ASA score did not demonstrate significant differences in early postoperative outcomes based on the discharge location alone. Finally, there may have been costs that were not captured during the initial encounter; however, the authors recorded 30- and 90-day postoperative costs to capture them. Finally, the results reported only capture short-term outcomes. Further longitudinal studies should be performed to compare mid- and long-term results after outpatient surgeries in this setting.

Conclusion

As TJA continues to shift to the outpatient setting, there is a push for hospitals and orthopedic providers to decrease a patient's LOS postoperatively. The transition to outpatient TJA at stand-alone ASCs is well documented in the literature; however, there are limited data on outpatient surgeries performed at a large academic medical center. The present study demonstrates that patients discharged from an outpatient SCU trended toward improved short-term outcomes and had significantly decreased cost of encounter, which remained lower at 30 and 90 days postoperatively. This proves the transition to outpatient TJA is feasible for large academic medical centers with proper implementation programs and practices and will help enhance arthroplasty programs at large tertiary academic centers.

Conflicts of interest

Dr. M. Bolognesi receives royalties from Zimmer and Total Joint Orthopedics; is in the speakers' bureau of or gave paid presentations for Smith & Nephew, Zimmer, and Total Joint Orthopedics; is an unpaid consultant for Amedica; has stock or stock options in Total Joint Orthopedics and Amedica; receives research support from Biomet, DePuy, a Johnson & Johnson company, Exactech Inc., and KCI; receives other financial or material support from Acelity, AOA Omega, and Smith & Nephew; is in the editorial or governing board of *Arthroplasty Today* and the *Journal of Arthroplasty*; and is a board member of the American Association of Hip and Knee Surgeons and the Eastern Orthopedic Association. Dr. T. Seyler receives royalties from Total Joint Orthopedics, Pattern Health, and Restor3D; is a paid consultant for Smith & Nephew, Total Joint Orthopedics, and Heraeus; receives research support from Zimmer and Next Science; receives financial or material support from Lippincott Williams and Wilkins; and is a board member of the American Association of Hip and Knee Surgeons and the Musculoskeletal Infection Society. The other authors declare no potential conflicts of interest.

Table 5
Encounter, 30-day, and 90-day cost of THAs and TKAs.

Cost	THA (n = 431)				TKA (n = 661)			
	Overall	SCU	Inpatient	*P* value	Overall	SCU	Inpatient	*P* value
Encounter	9212.00	8825.50	9648.00	**<.01**	9298.00	8899.00	10,038.50	**<.01**
30-D	9212.00	8825.50	9648.00	**<.01**	9298.00	8899.00	10,038.50	**<.01**
90-D	9248.00	8843.50	9658.00	**<.01**	9333.00	8914.00	10,065.00	**<.01**

Significant *P*-values are bolded.

For full disclosure statements refer to https://doi.org/10.1016/j.artd.2022.09.017.

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