The Journal of Arthroplasty 36 (2021) 30−36

Contents lists available at ScienceDirect

The Journal of Arthroplasty

journal homepage: www.arthroplastyjournal.org

Health Policy & Economics

Safety of Same and Next Day Discharge Following Revision Hip and Knee Arthroplasty Using Modern Perioperative Protocols

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ARTICLE INFO

Article history:
Received 14 April 2020
Received in revised form
23 July 2020
Accepted 23 July 2020
Available online 30 July 2020

Keywords:
total joint arthroplasty
outpatient
rapid recovery
revision
readmissions
complications

ABSTRACT

Background: Advances in perioperative care have enabled early discharge and outpatient primary total joint arthroplasty (TJA). However, the safety of early discharge after revision TJA (rTJA) remains unknown and the COVID-19 pandemic will force decreased hospitalization. This study compared 90-day outcomes in patients undergoing aseptic rTJA discharged the same or next day (early) to those discharged 2 or 3 days postoperatively (later).
Methods: In total, 530 aseptic rTJAs performed at a single tertiary care referral center (December 5, 2011 to December 30, 2019) were identified. Early and later discharge patients were matched as closely as possible on procedure type, sex, American Society of Anesthesiologists physical status classification, age, and body mass index. All patients were optimized using modern perioperative protocols. The rate of 90-day emergency department (ED) visits and hospital admissions was compared between groups.
Results: In total, 183 early discharge rTJAs (54 hips, 129 knees) in 178 patients were matched to 183 later discharge rTJAs (71 hips, 112 knees) in 165 patients. Sixty-two percent of the sample was female, with an overall average age and body mass index of 63 ± 9.9 (range: 18-92) years and 32 ± 6.9 (range: 18-58) kg/m^2. There was no statistical difference in 90-day ED visit rates between early (6/178, 3.4%) and later (11/165, 6.7%) discharge patients ($P = .214$). Ninety-day hospital admission rates for early (7/178, 3.9%) and later (4/165, 2.4%) discharges did not differ ($P = .545$).
Conclusion: Using modern perioperative protocols with appropriate patient selection, early discharge following aseptic rTJA does not increase 90-day readmissions or ED visits. As hospital inpatient capacity remains limited due to COVID-19, select rTJA patients may safely discharge home the same or next day to preserve hospital beds and resources for more critical illness.

Total joint arthroplasty (TJA) is one of the most successful of orthopedic procedures [1]. Historically, multiple days of inpatient care was the expectation following primary TJA. However, innovations in perioperative care, including surgical technique, pain management, blood conservation, and physical therapy, have enabled rapid recovery and early discharge [2−4]. Evidence demonstrates early discharge primary TJA (<24-hour stay) to be safe [5−12] and cost saving [13,14], without increasing readmission rates [15−17].

Conflict of Interest Statement: Each author certifies that he or she has no commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article.

Funding Statement: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethical Board Review statement: This study received Institutional Review Board approval prior to initiation. The study was performed in accordance with the ethical standards in the 1964 Declaration of Helsinki. This study was carried out in accordance with relevant regulations of the US Health Insurance Portability and Accountability Act (HIPAA).

One or more of the authors of this paper have disclosed potential or pertinent conflicts of interest, which may include receipt of payment, either direct or indirect, institutional support, or association with an entity in the biomedical field which may be perceived to have potential conflict of interest with this work. For full disclosure statements refer to https://doi.org/10.1016/j.arth.2020.07.062.

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https://doi.org/10.1016/j.arth.2020.07.062
0883-5403/

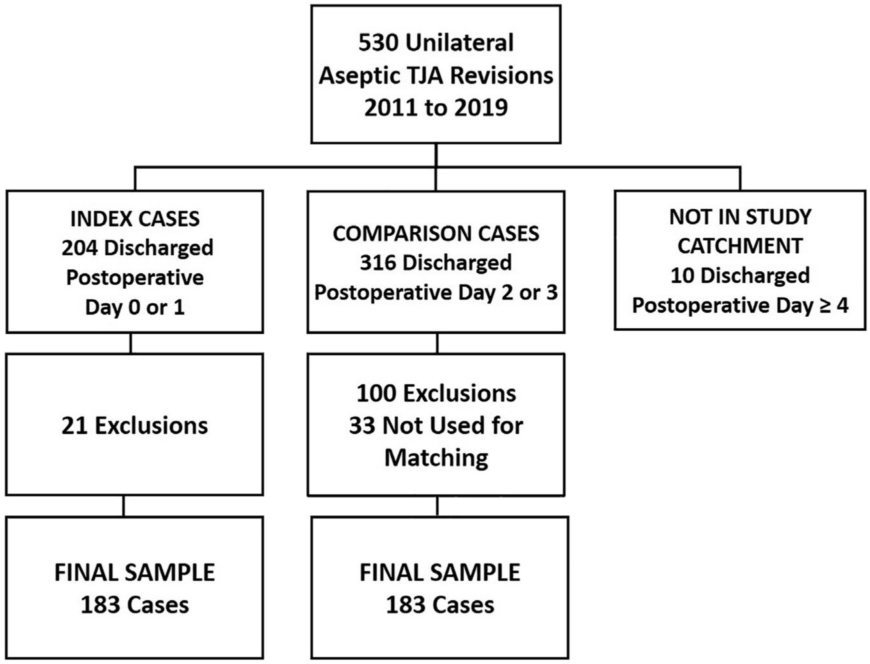

Fig. 1. Flowchart of index (LOS 0-1) and comparison (LOS 2-3) cases. LOS, length of stay; TJA, total joint arthroplasty.

Despite the clinical success of primary TJA, complications requiring revision remain a costly societal burden [18]. As the demand for TJA increases [19], so will the number of revisions [20]. The most common etiologies leading to revision total hip arthroplasty (rTHA) include instability, aseptic loosening, and infection [21]. The most common etiologies leading to revision total knee arthroplasty (rTKA) include infection, aseptic loosening, and instability [22,23]. Revision TJA (rTJA) traditionally results in longer inpatient lengths of stay (LOS) than primary TJAs. For example, in a 2009 study the average LOS following the most basic rTHA (head-liner exchange) was reported as 5 days and the average LOS for all types of rTHA procedures was over 6 days [21]. Similarly, the average LOS for an aseptic rTKA was reported to be over 4 days and increased to over 5 days when infection cases were included [22,23].

As surgeons, patients, and institutions become more comfortable with rapid recovery primary TJA, a natural evolution is to consider reducing inpatient LOS in the revision setting as well. Indeed, a goal for better healthcare is to reduce unnecessary waste by deterring patients and providers from the belief that “more is better” [24,25]. Furthermore, the COVID-19 pandemic of 2020 has brought to light our somewhat limited healthcare resources and highlighted our need to preserve inpatient hospital equipment and beds for patients stricken with severe medical illness. However, due to increased surgical complexity associated with rTJA and the associated physical stress on patients with medical comorbidities, early discharge after rTJA must be appropriately studied. The aim of this study is to compare 90-day readmission and emergency department (ED) visit rates between patients undergoing aseptic rTJA discharged the same or next day to those discharged 2 or more days postoperatively. Our null hypothesis was that there would be no difference in readmission and ED visit rates between the 2 groups.

Methods

Study Sample

In total, 530 unilateral aseptic rTJAs consecutively performed between December 5, 2011 and December 30, 2019 were identified in our TJA registry with Institutional Review Board approval. All cases were performed by a single surgeon at a dedicated hip and knee center in a tertiary care hospital. As shown in Figure 1, 204 (38.5%) rTJAs were discharged on postoperative day (POD) 0 or 1 (early discharge TJAs), 316 (59.6%) were discharged on POD 2 or 3 (later discharge TJAs), and 10 (1.9%) were hospitalized for 4 or more days. The latter cases were not included in the current study.

Twenty-one (10.3%) of the 204 early discharge rTJAs were excluded as shown in Table 1 leaving a final analysis sample of 183 index rTJAs. Table 1 shows that 100 (31.6%) of the 316 later discharge comparison cases were excluded leaving a pool of 216 cases to match to the 183 index cases. From this pool, 183 later discharge cases were matched as closely as possible to early discharge cases on procedure type (rTHA, rTKA), sex, American Society of Anesthesiologists physical status (ASA-PS) classification (1 through 4), age (±5 years), and body mass index (BMI) (±5 kg/m^2).

Patient Care Protocols

As part of our standardized perioperative care program, all patients underwent preoperative risk assessment and medical clearance within 4 weeks of surgery by a medical specialist whose practice focuses exclusively on hip and knee arthroplasty patients. Each patient’s upcoming surgery was discussed at a coordinated care conference attended by members of the multidisciplinary team the week prior to their scheduled surgery. During this

Table 1
Early and Late Discharge Revision Total Joint Arthroplasty Cases Excluded From Final Analysis and Reasons for Exclusion.

Exclusion Reason	Early Discharge Cases, n (%)	Later Discharge Cases, n (%)
Another procedure within a year	10 (47.6)	27 (27.0)
Distal femoral replacement	0 (0.0)	5 (5.0)
Extensor mechanism repair	2 (9.5)	10 (10.0)
Heterotopic ossification resection	0 (0.0)	2 (2.0)
Re-revised	9 (42.9)	56 (56.0)
Total	21 (100.0)	100 (100.0)

meeting, information is shared across disciplines and patient care plans are proactively developed, which are shared with everyone who provides direct care or services to the patient. Preoperatively, patients and family members received comprehensive clinic-based education and attended a hospital-based joint replacement class. Postoperatively, all patients were encouraged to ambulate by the afternoon on the day of surgery when possible and attempts were made to standardize rehabilitation protocols. Postoperative care was assumed by the operative surgeon, the internal medicine specialist, clinic staff, and a multidisciplinary inpatient care team. Postoperative pain control for the first 24 hours was by an anesthesia pain service. The same modern perioperative pain control, clinical, and rehabilitation protocols were used for all patients.

Perioperative and Postoperative Pain Control and Anesthesia Protocols

A multimodal preoperative pain protocol was used in all cases. Unless allergic or contraindicated, patients were given acetaminophen (1000 mg per os [PO]) 24 hours before surgery and oxycodone (10-20 mg PO), celecoxib (200 mg PO), and pregabalin (75 mg PO) immediately before surgery. Intraoperatively, surgeries were performed with standardized light general anesthesia (desflurane or sevoflurane) and a low-dose intrathecal, single-shot spinal injection of either 0.40 mg of morphine with a median of 10.5 mg bupivacaine local anesthetic or 25 mcg of fentanyl with a median of 7.5 mg bupivacaine. Beginning January 1, 2015, the spinal anesthesia medication cocktail was changed from morphine to fentanyl. Between September 1, 2012 and May 31, 2016, patients were instructed not to consume liquids after 12 AM on the day of surgery. Beginning on June 1, 2016, patients were allowed to drink liquids up to 2 hours before surgery. Postoperatively, patients were permitted to drink freely. Patient-specific, goal-directed fluid therapy called for preoperative, intraoperative, and postoperative administration of approximately 2000 mL total of crystalloid sodium lactate unless patients had significant renal diseases in which case normal saline was used. In knees only, a periarticular injection of 0.2% (200 mg) ropivacaine, 0.5 mg epinephrine, 80 mcg clonidine, and 30 mcg ketorolac (removed for patients with renal insufficiency) to equal 101.3 mL total volume was used immediately following final implant fixation. Postoperatively, unless allergic or contraindicated, patients received acetaminophen (1000 mg PO three times a day), OxyContin (10-20 mg PO q12 hours), celecoxib (200 mg PO twice a day), oxycodone (5-10 mg hourly pro re nata (prn) for mild pain and 10-20 mg hourly prn for moderate pain), or hydromorphone (0.5 mg IV q20 minutes prn for severe pain). IV tranexamic acid (1 g prior to incision followed by 1 g 2 hours later) was standardly used. Thromboprophylaxis was with enteric-coated aspirin 81 mg twice daily for 6 weeks along with 23 hours of sequential compression devices during hospitalization. Those patients at higher risk for thromboembolism were treated with additional chemoprophylaxis.

Data Analysis

Data were prospectively recorded in and retrieved from the electronic medical record and verified for accuracy. A retrospective review of the electronic medical record was completed for each patient. Demographic data including patient age in years, sex (male/female), BMI in kg/m^2, ASA-PS classification (1, 2, 3, or 4), type of procedure (rTHA or rTKA), and reason for revision were recorded. Details of the procedure were collected and categorized based on the components revised. Surgical case duration was defined as the length of time, in minutes, from procedure start to procedure stop. Discharge disposition was recorded. All-cause inpatient readmissions and ED visits within 90 days of surgery were recorded for each patient. For each readmission or ED visit, date, time, results, and cause for the readmission or visit were recorded.

Minitab 19 (Minitab Inc, State College, PA) was used for data analysis. Continuous data are reported as means with standard deviations, and categorical data are reported as numbers and percentages. Means and standard deviations in early and later discharge cases were compared using Student's *t*-test and the Pearson chi-squared test was used to compare categorical variables. ED visit and hospital readmission rates in the 2 groups were compared with the 2-proportion test using Fisher's exact *P* value. A critical *P* value of .05 was set for all comparisons. The project described was supported by the Indiana University Health – Indiana School of Medicine Strategic Research Initiative.

Results

Demographic and case characteristics for the 2 study groups are shown in Table 2. rTHA was performed in 30% of early discharge and 39% of later discharge patients ($P = .078$). Fifty-eight percent of early discharge and 66% of later discharge patients were female ($P = .162$). The average age (62.6 vs 64.2 years) and BMI (32.5 vs 32.3 kg/m^2) of early and later discharge patients, respectively, were not significantly different. ASA-PS classification was similarly distributed in the 2 groups ($P = .094$). Fewer later discharge patients had private insurance with more of them insured by Medicare ($P = .017$). On average, mean procedure time was 24 minutes longer in later discharge patients ($P < .001$).

Revision etiology for early discharge and later discharge cases is shown separately for hip and knee procedures in Table 3. Adverse local tissue reaction was the most common reason for rTHA in early discharge patients, whereas loosening was more common in later discharge patients ($P = .008$). In knees, instability was the most prevalent cause of revision for both early and later discharge patients ($P = .152$). Components revised in early discharge and later discharge cases are shown in Table 4. Revision of both acetabular and femoral components was most common in early discharge rTHA patients, whereas acetabular revision alone was more common in later discharge rTHA patients ($P < .001$). The majority of early and later discharge rTKA patients underwent both femoral and tibial component revision ($P = .063$).

Table 2
Comparison of Demographics and Case Characteristics in Early and Later Discharge Aseptic Revision TJAs.

Demographic/Case Characteristic	Early Discharge Cases	Later Discharge Cases	*P* Value
No. of cases	183	183	
No. of patients	178	165	
% Female	57.9	65.6	.162
% Male	42.1	34.4	
Age (y), mean (SD)	62.6 (9.5)	64.2 (10.3)	.132
BMI (kg/m^2), mean (SD)	32.5 (7.0)	32.3 (6.8)	.755
% rTHA	29.5	38.8	.078
% rTKA	70.5	61.2	
ASA-PS classification			
1	0.5	1.1	.094
2	38.3	33.3	
3	60.7	61.2	
4	0.5	4.4	
Insurance type			
% Medicaid	9.8	7.7	.017
% Medicare	49.0	63.9	
% Private	40.1	28.4	
Procedure time (min), mean (SD)	111.6 (34.2)	135.7 (48.5)	<.001

TJA, total joint arthroplasty; BMI, body mass index; SD, standard deviation; rTHA, revision total hip arthroplasty; rTKA, revision total knee arthroplasty; ASA-PS, American Society of Anesthesiologists physical status.

Table 3
Revision Indications in Early and Later Discharge Aseptic Revision TJAs.

Indication	Total		Early DC Cases		Later DC Cases		*P* Value
	n	%	n	%	n	%	
THA revisions							
ALTR	31	24.8%	17	31.5%	14	20.0%	.008
Component malposition	5	4.0%	5	9.3%	0	0.0%	
Instability	24	19.2%	13	24.1%	11	15.7%	
Loosening	50	40.0%	16	29.6%	34	48.6%	
Osteolysis/polyethylene wear	12	9.6%	2	3.7%	10	14.3%	
Other	3	2.4%	1	1.9%	1	1.4%	
Total	125	100.0%	54	100.0%	70	100.0%	
TKA revisions							
Arthrofibrosis	21	8.7%	16	12.4%	5	4.5%	.152
Component malposition	3	1.2%	1	0.8%	2	1.8%	
Instability	115	47.7%	65	50.4%	50	44.6%	
Loosening	83	34.4%	37	28.7%	46	41.1%	
Osteolysis/polyethylene wear	14	5.8%	7	5.4%	7	6.3%	
Other	5	2.1%	3	2.3%	2	1.8%	
Total	241	100.0%	129	100.0%	112	100.0%	

ALTR, adverse local tissue reaction; DC, discharge; TJA, total joint arthroplasty; THA, total hip arthroplasty; TKA, total knee arthroplasty.

One later discharge patient transitioned to a skilled nursing facility. Among the remainder of patients, all early discharge patients went home with 75.8% of later discharge patients going home and 24.2% transitioning to a rehabilitation facility ($P < .001$). ED visits and hospital admissions within 90 days of aseptic revision TJA are shown in Table 5. Six (6/178, 3.4%) early discharge patients and 11 (11/165, 6.7%) later discharge patients presented to the ED ($P = .214$). Complaints ranged from nausea to shortness of breath and surgical site bleeding, all of which were resolved without subsequent hospital admission (Table 5). Three patients in each group (3/178, 1.7% vs 3/165, 1.8%; $P = 1.00$) presented to the ED and were subsequently admitted to the hospital (Table 5). Causes ranged from allergic rash to a pain pump to acute hematogenous infection in the study joint requiring irrigation and debridement with component retention. Table 5 also shows that 4 early discharge patient (4/178, 2.2%) and 1 later discharge patient (1/165, 0.06%) were directly admitted to the hospital within 90 days of rTJA ($P = .373$). One of the early discharge patients was admitted for non-ST segment elevation myocardial infarction and the others required surgical intervention for superficial wound and/or soft tissue repair. The later discharge patient was directly admitted for acute confusional state with 104° temperature and evidence of pneumonia.

Discussion

Over the past decade and a half, there has been a shift from a "sick-patient model" to a "well-patient model" among patients undergoing elective primary TJA, with optimization occurring prior to surgery and many patients not requiring a prolonged hospital stay. An enhanced understanding of multimodal approaches to pain management, blood conservation, and early mobilization have improved the standardization of care for TJA patients, which has increased the efficiency of care [5–7,9,26]. Rapid recovery for primary TJA has been successfully performed in multiple patient populations, with low rates of complications and readmissions, even among elderly patients [16,27–29]. In its current state, appropriately performed rapid recovery primary TJA is a safe [30], cost-efficient [14,31,32], and patient-friendly strategy [33]. However, there remains disagreement on the optimal inpatient LOS, with some authors criticizing outpatient TJA as risky and claiming longer inpatient stays allow for the recognition of life-threatening complications and those complications that prompt readmission [34,35].

The exponentially increased demand for TJA has imposed an enormous economic burden on the healthcare system, accounting for more Medicare expense than any other inpatient procedure [36]. Not surprisingly, resource utilization and cost containment have become a primary focus of policy and research on primary and rTJA. Multiple strategies have been adopted to improve the value of TJA, including a reduction in wasteful spending and a reduction in hospital LOS [13]. As surgeons, patients, and institutions become more comfortable with rapid recovery primary TJA, it is likely a similar trend will follow among patients requiring rTJA. To prevent an increase in perioperative complications and assure the focus is

Table 4
Components Revised in Early and Later Discharge Aseptic Revision TJAs.

Component	Total		Early DC Cases		Later DC Cases		*P* Value
	n	%	n	%	n	%	
THA revisions							
Both AC and FC	46	36.8%	29	53.7%	17	23.9%	<.001
AC only	35	28.0%	4	7.4%	31	43.7%	
FC only	18	14.4%	5	9.3%	13	18.3%	
Head and liner exchange	26	20.8%	16	29.6%	10	14.1%	
Total	125	100.0%	54	100.0%	71	100.0%	
TKA revisions							
Both FC and TC	106	82.2%	103	92.0%	209	86.7%	.063
FC only	8	6.2%	6	5.4%	14	5.8%	
TC only	3	2.3%	1	0.9%	4	1.7%	
Polyethylene exchange	12	9.3%	2	1.8%	14	5.8%	
Total	129	100.0%	112	100.0%	241	100.0%	

AC, acetabular component; DC, discharge; FC, femoral component; TC, tibial component; TJA, total joint arthroplasty; THA, total hip arthroplasty; TKA, total knee arthroplasty.

Table 5
Ninety-Day ED Visits and Hospital Admissions in Early and Later Discharge Aseptic Revision TJAs.

Encounter Type	Early Discharge Cases	Later Discharge Cases
ED visit only	N = 6 Cough Bleeding surgical wound (study joint) Bilateral lower extremity edema Concern for GI bleed, but no bleeding found Study joint dislocation requiring closed reduction Severe headache, resolved	N = 11 Weakness, hypotension, dehydration Nausea Acute fever normal at presentation Pain in study joint (3) Shortness of breath (3) DVT Pain medication seeking
ED followed by inpatient admission	N = 3 Acute on chronic CHF exacerbation Acute hematogenous infection of study joint treated with I&D and component retention Rash reaction to pain pump	N = 3 Non-study joint pain and swelling Study joint superficial wound I&D and aspiration Nausea, vomiting, abdominal pain, likely from constipation
Inpatient admission only	N = 4 Study joint superficial wound I&D NSTEMI Superficial seroma evacuation and retinacular defect repair (study joint) Fall with knee dislocation and extensor mesh rupture (study joint)	N = 1 Acute confusional state with 104° temperature and evidence of pneumonia

CHF, congestive heart failure; DVT, deep vein thrombosis; ED, emergency department; GI, gastrointestinal; I&D, irrigation and debridement; NSTEMI, non-ST segment elevation myocardial infarction; TJA, total joint arthroplasty.

on patient safety, as opposed to financial incentives, we sought to determine the safety of a reduced hospital LOS in aseptic rTJA patients using modern perioperative protocols. The results of this study demonstrated no significant difference in the 90-day readmission or ED visit rates between patients undergoing aseptic rTJA discharged on POD 0 or 1 compared to those patients discharged on POD 2 or later. These are novel findings, as this is the first paper, to the authors' knowledge, that reports on the safety of early discharge revision TJA.

The results of this study are similar to a large database study presented at the 2019 Annual Meeting of the American Academy of Orthopedic Surgeons by Gu et al [37], which analyzed all patients in the American College of Surgeons National Surgical Quality Improvement Program database who underwent aseptic rTKA and were discharged 0-2 days after the procedure and compared to those discharged 3-4 days postoperatively. The authors found no difference in the 30-day complication rate between the 2 groups. In contrast to the study by Gu et al, a major strength of the present study is the lack of selection bias inherent in a large database study. Specifically, all patients included in our study were exposed to the same modern perioperative protocols. Additionally, a large database study lacks the appropriate granularity to adjust for institutional protocols or other medical reasons that may delay discharge following rTKA. Our study utilized matching on multiple potential confounders, including age, ASA status, sex, and BMI to reduce this bias. However, it is possible that uncontrolled variables played a role in the timing of discharge, such as surgical duration, complexity of the surgery, or other social confounders. Future studies should investigate these variables further to determine whether a particular combination of patient and surgical factors decreases the safety of early discharge. Despite not detecting a statistically significant difference in ED visit rates between the early and late discharge rTJA patients, there were 10 more ED visits in the early discharge patients than the late discharge patients. It is possible that we lacked the numbers necessary to detect a statistically significant difference, representing type 2 error. It should be emphasized that the authors of this study do not interpret the results to mean every aseptic rTJA should be discharged early. Instead, patients should only be discharged when they are medically and socially safe for discharge. It appears that when this approach is taken, appropriately selected aseptic rTJA patients may be discharged early without an increase in complications.

The results of this study are comparable to those found in investigations of early discharge after primary TJA. For example, a study conducted at a Veteran's Affairs hospital compared patients discharged within 1 day to more than 1 day following primary TJA. The authors reported no significant difference in returns to the operating room, readmissions to the hospital, or visits to the ED [38]. Similarly, in a large database query of 1220 outpatient primary TJAs between 2011 and 2014, Courtney et al [39] reported no increased risk of readmissions or complications, a finding that has been reproduced in a number of other studies [40–42]. Moreover, Feder et al [43] evaluated the safety of 850 same day discharge TJA patients at a single institution and noted a 90-day readmission rate of 0.94% and a 90-day ED rate of 1.18%. The higher rates noted in our study can be explained by the findings of Schairer et al, who showed that patients undergoing revision TKA [44] and THA [45] were more likely to have an unplanned readmission than patients undergoing primary TJA. The all-cause 90-day readmission rate in their studies was 8.8% in hips and 13% in knees, which is higher than the results found in our study. Edwards et al [46] also evaluated the safety of rapid recovery TJA, including octogenarians and revisions. Despite a developed clinical pathway, the authors noted an overall 90-day readmission rate of 15% in THAs and 12% in TKAs, which are also higher than ours, though direct comparison is limited given the different patient populations. The lower rates reported in our series may also reflect differences in our clinical pathway including the multidisciplinary team approach; however, additional research is required to establish this.

This study is not without limitations, including its retrospective cohort design. Despite the inherent bias of the study design, all data were prospectively collected on consecutive cases performed with consistent institutional protocols, which may reduce selection and interpretation biases. However, it is possible that the matching criteria used to match the early and later discharge patients did not account for potential confounding variables that may have influenced the results in a way that was not detected statistically. For example, there were significantly more private insurance patients in the early discharge group and more Medicare patients in the later discharge group. Moreover, though not statistically significant, the case complexity was different between early and late discharge rTHAs. Specifically, more of the late discharge rTHAs had diagnoses of aseptic loosening and osteolysis, whereas more of the early discharge rTHAs had adverse local tissue reaction. It is possible that the difference in diagnosis was associated with an increased level of surgical complexity or bone loss and that this difference was associated with a longer LOS. Future studies may seek to evaluate whether increased surgical complexity is associated with longer LOS in aseptic rTHA. Additionally, this study excluded patients undergoing revision for PJI, in part because none of the infection cases performed during the study period were discharged early, within POD 0 or 1. Therefore, this study is not generalizable to the PJI patient population. We chose not to include these patients as controls as they are oftentimes more medically complex, have defined logistical issues related to orchestrating long-term intravenous antibiotics mandating an extended hospital stay, and have higher unplanned readmission rates [44,45], which would have introduced significant bias. Future studies should seek to determine whether a reduction in LOS among patients with PJI has a detrimental effect on outcomes including readmission rates, complication rates, and infection eradication rates. Moreover, it should be noted that this study only evaluated readmission and ED visit rates and did not evaluate other outcomes such as patient-reported outcome measures or long-term success of the implants. Finally, the results of this study are generalizable, in as much as one is able to adopt the multidisciplinary approach described in the present study. One part of the multidisciplinary approach is attendance at the joint replacement class, which is strongly suggested for all revision patients. We did not record the relative number of participants in each group and this may also represent a source of confounding and future studies should determine whether this affects discharge timing and safety in aseptic rTJA. This study demonstrates the feasibility and safety of short stay rTJA, but also emphasizes the fact that even with a multidisciplinary approach and rapid recovery protocols, not all revision patients will be safe to undergo early discharge.

In conclusion, this study demonstrates the relative safety of early discharge of aseptic rTJA patients without an increase in readmission or ED visits within the first 90 days after surgery. As LOSs following rTJA continue to decrease, it is crucial to create evidence-based safeguards to assure that focus remains on patient safety to keep the perioperative complication rates as low as possible. Implementation of a multidisciplinary approach to patient care is essential to predicting patient needs in the perioperative period and improves the safety and feasibility of early discharge patients undergoing aseptic rTJA.

Acknowledgments

The project described was supported by the Indiana University Health – Indiana School of Medicine Strategic Research Initiative.

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