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Original research

Do shorter lengths of stay increase readmissions after total joint replacements?

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Background: Enhanced recovery after surgery protocols for total joint replacements (TJRs) emphasize early discharge, yet the impact on readmissions is not well documented. We evaluate the impact of a one-day length of stay (LOS) discharge protocol on readmissions.
Methods: We conducted a retrospective review of all primary TJRs (hip and knee) from April 2014 to March 2015. Patients who had adequate support to be discharged home were categorized into 2 groups, 1-day (n = 174) vs 2-day (n = 285) LOS groups. Patients discharged to rehabilitation were excluded (n = 196).
Results: Patients in the 1 day group were more likely to be younger (61.7 vs 64.8 years, $P < .001$), be male (56.3% vs 40.4%, $P = .001$), and have a lower body mass index (30.0 vs 31.4 kg/m^2, $P = .012$). One-day LOS patients had shorter surgical times (79.7 vs 85.6 minutes, $P = .001$) and more likely had spinal anesthesia (46.0% vs 31.2%, $P = .001$). The overall 30-day all-cause (2.3% vs 2.5%, $P = .591$) and 90-day wound-related (1.1% vs 1.1%, $P = .617$) readmission rates were equivalent between groups.
Conclusions: Early discharge does not increase readmissions and may help attenuate costs associated with TJRs. Further refinement of protocols may allow for more patients to be safely discharged on postoperative day 1.

Introduction

Enhanced recovery after surgery (ERAS) programs expedite postoperative recovery, support an early discharge, and decrease postoperative complications by promoting a multidisciplinary approach to patient care [1]. Originally developed for colon surgery, ERAS pathways are being adopted across a range of surgical specialties [2–4]. Developed using evidence-based medicine, ERAS emphasizes a reduction in postoperative morbidity with strategies targeting anesthesia, analgesia, fluid management, nutrition, and postoperative ambulation [1]. Specifically for total joint replacements (TJRs), protocols include preoperative patient education and preparation, regional anesthesia, multimodal nonopioid pain management, aggressive postoperative fluid administration, and early mobilization [5–7].

According to the Centers for Disease Control and Prevention, there were 1.1 million TJRs performed in the United States in 2012, costing US $18.75 billion [8]. By 2030, the demand for TJRs is projected to increase by 174% for primary total hip arthroplasties and 673% for primary total knee arthroplasties [9]. With two-thirds of all TJRs in the United States being performed on Medicare beneficiaries, these procedures represent a financial burden to the Centers for Medicare & Medicaid Services (CMS) [10,11]. Efforts to contain rising costs led to the creation of a bundled payments reimbursement model, which rewards hospitals and surgeons that can control costs. An important way to decrease costs is to decrease hospital length of stay (LOS).

Early concerns have been raised that decreasing hospital stay may result in an increase in hospital readmissions; however, studies demonstrate that ERAS programs shorten LOS without increasing complications or readmissions [12–18]. In 2014, CMS updated its Readmissions Reduction Program to improve patient outcomes after TJRs [10]. These TJR-specific quality measures define 7-day, 30-day, and 90-day causes for readmissions [19]. Hospitals now incur a financial penalty for complications and readmissions associated with TJRs.

Rapid recovery and shorter lengths of stay have become an early measure of success after TJRs for both patients and hospitals.

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With growing emphasis on cost efficiency, research efforts are now being directed at updating ERAS pathways to further shorten hospital stay, without adversely impacting patient outcomes [20–22]. The purpose of this study was to evaluate our readmissions rate after updating our institution's ERAS program to promote a 1-day LOS discharge protocol. The primary end point of this study was to quantify the overall all-cause 30-day readmissions rate. Secondary end points were to identify variables associated with a shorter LOS.

Material and methods

All TJRs at our institution were performed under our ERAS program. This includes preoperative, intraoperative, and postoperative protocols for care delivery. Preoperative measures were patient education, physical therapy, and medical evaluations. Patient education involved educational programs overviewing daily activities after surgery, identifying a specific care companion "Coach" at home, and discussing expectations. Preoperative physical therapy aimed to strengthen the upper and lower extremities. All patients had a medical evaluation within 30 days of surgery. Perioperative protocols included regional anesthesia, multimodal pain management, aggressive intraoperative fluid management, tranexamic acid utilization, anticoagulation prophylaxis, and day of surgery ambulation. Table 1 summarizes our pharmacological protocol. Standard Surgical Care Improvement Guidelines for perioperative antibiotics was followed. Pharmacologic (Aspirin 325 mg bid or Coumadin INR 1.8-2.4) and mechanical postoperative deep vein thrombosis prophylaxis was maintained in all patients. Oxycodone (5 mg increments as needed) was prescribed for pain unresponsive to nonopioid analgesics.

On April 1, 2014, our ERAS program was updated to promote an earlier (1 day LOS) discharge protocol. Specifically, patient education was updated to set expectations for discharge. Perioperative modifications included the increased use of regional anesthesia. The use of femoral nerve blocks for TKRs was discontinued. Patient-controlled anesthesia was discontinued. Day of surgery mobilization was attempted in almost all patients. Acetaminophen (975 mg) was added to the postoperative analgesic medication list.

Table 1
Enhanced recovery after surgery pharmacological protocol.

Preoperative pain management (single dose within 2 h of incision)
Acetaminophen 975 mg PO
Lyrica 50 mg PO
Protonix 40 mg PO
Oxycontin 10 mg PO
Scopolamine patch[a]
Celebrex 200 mg PO[b]
Tranexamic acid (TXA)
Total knee replacement
Preincision 10 mg/kg, maximum dose 1000 mg
3 h after incision 10 mg/kg, maximum dose 1000 mg
Total hip replacement
Preincision 10 mg/kg, maximum dose 1000 mg
Periarticular injection
Morphine 5 mg
Toradol 15 mg[a]
Ropivicaine 0.5% 30 cc
Epinephrine 1/1000 0.3 cc
Saline 30 cc
Postoperative pain management
Total knee replacement
Acetaminophen 975 mg PO q 4 as needed
Lyrica 50 mg PO bid × 14 d
Celebrex 200 mg PO qd × 30 d
Oxycodone 5 mg as needed
Total hip replacement
Acetaminophen 975 mg PO q 4 as needed
Oxycodone 5 mg as needed
Lyrica 50 mg PO bid × 14 d[c]

PO, per oral.
[a] Unless contraindicated.
[b] Not given if periarticular injection included Toradol 15 cc.
[c] In select patients with breakthrough pain.

Study design

Institutional review board approval was obtained. A prospectively maintained institutional Joint Outcomes database was queried for all primary total hip and knee replacements. All procedures were performed by 2 surgeons from April 2014 to March 2015. The 2 surgical techniques used for THRs were the direct anterior and posterior-lateral approach. There was no criterion for assigning patients to a particular surgical technique. It was determined using patient and surgeon preference. All TKRs were performed via a standard medial patellar arthrotomy. The new 1-day LOS protocol was introduced on April 1, 2014. The aim of this study was to evaluate the impact of an earlier (1-day LOS) discharge on readmissions.

A total of 655 TJRs met our initial criteria, of which 196 were discharged to rehabilitation and excluded. This exclusion criterion was based on Medicare's requirement for a minimum 3-day inpatient stay for patients to go to a skilled nursing facility. This left a total of 459 (70%) TJRs in this study. Patients were then categorized into the 1-day or 2-day LOS groups. Length of hospital stay was determined by medical clearance and the ability to safely ambulate after surgery.

Patient demographics of age, gender, body mass index (BMI), and comorbidity were recorded. Table 2 summarizes the patient demographics for patients discharged to rehabilitation facilities that were excluded (LOS $\geq$ 3 days) from this study. The primary end points were our readmissions rate, which were assessed using CMS's TJR-specific quality measures [19]. Secondary end points examined variables associated with early discharge.

CMS TJR-specific quality measures: patients were evaluated for a total of 8 postoperative complications [19]. Patients presenting with an acute myocardial infarct, pneumonia, or sepsis/septicemia/shock during the index of admission or within 7 days of admission

Table 2
Patient demographics for patients excluded from study.

Demographics	LOS $\geq$3 d
N	196
Age (y)	70.4
Body mass index (kg/m^2)	31.2
Gender	
Male	28.6%
Female	71.4%
Comorbidity	
Diabetes	25.0%
Hypertension	74.0%
Hyperlipidemia	57.7%
Gastroesophageal reflux disease	42.3%
Coronary artery disease	12.2%
Chronic obstructive pulmonary disease	11.7%
Congestive heart failure	4.6%
Liver cirrhosis	0.5%
Atrial fibrillation	14.3%
Pacemakers	1.5%
Past medical history	
History of DVT/PE	5.6%
History of CVA/TIA	8.2%
History of myocardial infarct	4.1%

CVA, cerebrovascular accident; DVT, deep vein thrombosis; PE, pulmonary embolism; TIA, transient ischemic attack.

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Table 3
Patient demographics (n = 459).

Demographics	1-day LOS	2-day LOS	*P* value
N	174	285	
Age (y)	61.7 ± 8.6	64.8 ± 8.6	**<.001**
Body mass index (kg/m^2)	30.0 ± 5.8	31.4 ± 6.0	**.012**
Gender			**.001**
Male	98 (56.3%)	115 (40.4%)	
Female	76 (43.7%)	170 (59.6%)	
Comorbidity			
Diabetes	18 (10.3%)	38 (13.3%)	.343
Hypertension	96 (55.2%)	193 (67.7%)	**.007**
Hyperlipidemia	87 (50.0%)	160 (56.1%)	.200
Gastroesophageal reflux disease	45 (25.9%)	84 (29.5%)	.404
Coronary artery disease	12 (6.9%)	37 (13.0%)	**.041**
Chronic obstructive pulmonary disease	6 (3.4%)	14 (4.9%)	.456
Congestive heart failure	1 (0.6%)	3 (1.1%)	.593
Liver cirrhosis	1 (0.6%)	2 (0.7%)	.870
Atrial fibrillation	12 (6.9%)	27 (9.5%)	.337
Pacemakers	—	5 (1.8%)	.079
Past medical history			
History of DVT/PE	4 (2.3%)	18 (6.3%)	**.051**
History of CVA/TIA	5 (2.9%)	16 (5.6%)	.173
History of myocardial infarct	4 (2.3%)	15 (5.3%)	.122

The bold signifies *P* values that meet statistical significance.
CVA, cerebrovascular accident; DVT, deep vein thrombosis; PE, pulmonary embolism; TIA, transient ischemic attack.

were reported. Surgical site bleeding, pulmonary embolisms, and deaths were recorded within the 30-day postoperative period. Mechanical complications and periprosthetic joint and wound infections were assessed up to 90 days postoperatively.

Statistical analysis

The Pearson's chi-square test was used to analyze categorical variables, such as gender, comorbidity, and incidence of readmissions, between the 1- vs 2-day LOS groups. Two-sided Fisher's exact test was used for categorical variables that did not achieve sufficient power for chi-square analysis, defined as when a cell had an expected frequency of 5 or less. One way analysis of variance was used for continuous variables, such as age, BMI, surgical time, and blood loss. All analyses were performed using IBM SPSS Statistics version 23 (Armonk, NY). A *P* value less than or equal to .05 was treated as statistically significant.

Results

A total of 459 TJRs were included in this study. The 1-day group (n = 174) comprised 86 TKRs and 88 THRs, whereas the 2-day group (n = 285) comprised 168 TKRs and 117 THRs. Patients in the 1-day group were more likely to be younger (61.7 vs 64.8 years, $P < .001$), be male (56.3% vs 40.4%, $P = .001$), and have a lower BMI (30.0 vs 31.4 kg/m^2, $P = .012$) status compared to the 2-day group (Table 3).

Table 4
Preoperative risk.

Variable	1-day LOS (%)	2-day LOS (%)	*P* value
ASA score			.115
1	4.0	1.8	
2	71.3	64.4	
3	23.6	31.7	
4	1.1	2.1	
Number of comorbidity			.146
None	17.8	11.2	
1	28.2	25.6	
2	28.7	25.3	
3	16.1	20.0	
≥4	9.2	17.9	

Table 5
Perioperative data.

Variable	1-day LOS	2-day LOS	*P* value
Anesthesia type			**.001**
General	94 (54.0%)	196 (68.8%)	
Spinal	80 (46.0%)	89 (31.2%)	
Anterior approach to THA	73 (83.0%)	76 (65.0%)	**.004**
Skin-to-skin operating time (min)	79.7 ± 14.9	85.6 ± 23.5	**.001**
Estimated blood loss (mL)	234.0 ± 158.3	264.8 ± 215.5	.104
Preoperative hematocrit	41.8 ± 3.4	41.4 ± 3.7	.217
PACU hematocrit	37.3 ± 3.9	36.3 ± 3.8	.213
POD 1 hematocrit	33.6 ± 3.9	33.3 ± 3.7	.364
Preoperative hemoglobin	14.1 ± 1.3	13.9 ± 1.3	.143
POD 1 hemoglobin	11.0 ± 1.1	11.3 ± 1.3	.303

The bold signifies *P* values that meet statistical significance.
PACU, postoperative acute care unit; THA, total hip arthroplasty.

A larger percentage of patients in the 2-day cohort presented with hypertension ($P = .007$), coronary artery disease ($P = .041$), and deep vein thrombosis/pulmonary embolisms ($P = .051$). The overall number of comorbidity ($P = .146$) or American Society of Anesthesiologists (ASA) score ($P = .115$) did not differ between groups (Table 4).

Patients in the 1-day group more often had spinal anesthesia (46.0 % vs 31.2%, $P = .001$), THRs via the direct anterior approach (83.0% vs 65.0%, $P = .004$), and shorter surgical times (79.7 vs 85.6 minutes, $P = .001$). Intraoperative blood loss and postoperative hematocrit or hemoglobin levels did not differ between groups (Table 5).

No patients presented with an acute myocardial infarct, pneumonia, or sepsis episode within 7 days of surgery (Table 6). No surgical site bleeds or deaths were noted in the 30-day postoperative period. The incidence of pulmonary embolisms did not differ between groups ($P = .434$). The 90-day readmissions rate for wound-related complications were similar for patients in the 1- and 2-day LOS cohorts (1.1% vs 1.1%, $P = .617$). Two patients in the 1-day LOS group were readmitted for wounds infections within 90 days of surgery. One required 2 debridement procedures whereas the other was managed medically. Of the 3 patients readmitted within 90 days of surgery in the 2-day LOS group, one patient required manipulation under anesthesia for stiffness, one required debridement for a wound infection, and another presented with a methicillin-resistant Staphylococcal prosthetic joint infection that required 2 surgical procedures.

The overall all-cause 30-day readmissions rate did not differ for patients in the 1- and 2-day LOS groups (2.3% vs 2.5%, $P = .591$). Four patients in the 1-day LOS cohort had 5 readmission events within 30 days of surgery. Two patients presented with the previously described wound-related complications, one was readmitted for hyperglycemia and another for syncope secondary to orthostatic hypotension. The latter 2 patients were managed conservatively. In the 2-day cohort, 7 patients were readmitted within 30 days of surgery. In addition to the previously described prosthetic join infection, the other causes for readmission in this subgroup were postoperative ileus (n = 2), pulmonary embolism, upper

Table 6
Postoperative complications.

Readmissions	1-day LOS	2-day LOS	*P* value
7-day readmissions	(0) 0%	(0) 0%	–
30-day readmissions	(0) 0%	1 (0.4%)	.434
Pulmonary embolism	—	1	
90-day readmissions	2 (1.1%)	3 (1.1%)	.617
Prosthetic joint infections	—	1	
Wound infections	2	2	
30-day all-cause readmissions	4 (2.3%)	7 (2.5%)	.591

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extremity paresthesia, laparoscopic cholecystectomy, and atrial fibrillation. All were managed medically.

Discussion

ERAS pathways lower postoperative morbidity and mortality using multimodal interventions aimed at decreasing stress-induced organ dysfunction [23]. Specifically in TJR surgery, ERAS decreases the need for blood transfusions [12,16], decreases returns to the operating room [12], and reduces 30- and 90-day mortality [12,13,15,17]. Emphasizing an early discharge, these programs help attenuate costs associated with TJRs [24–27] without correspondingly increasing complications or readmissions [12–17].

Our study demonstrates that you can promote a 1-day LOS discharge protocol to patients undergoing TJRs, without adversely impacting outcomes. We observed no increase in early complications or readmissions between the 1- and 2-day LOS patients in our updated ERAS program. Our findings are consistent with other studies [7,14]. Stambough et al. [14] conducted a retrospective review of 1751 primary THRs and observed a 52% reduction in LOS after the implementation of an ERAS pathway. The study reported no subsequent increase in the overall 30-day readmissions rate. Similarly, Husted et al. [7] decreased average LOS by 3.2 days without correspondingly increasing readmissions.

Prior investigations have explored the reasons for readmissions after TJRs [28–30]. Our findings are consistent with these reports, with infection- and procedure-related complications being the most common reasons for readmission. Studies have also reported risk factors correlating with readmissions after TJRs [28,31–33]. Saucedo et al. [28] found that age <50 or >80 years, BMI <18.5 or ≥30, diabetes, coronary artery disease, and hospital stays ≥5 days increased the risk for readmissions [28]. Bini et al. [34] report that patients discharged to a skilled nursing facility were more likely to be readmitted vs those discharged to home; however, Tayne et al. [35] found no correlation between discharge disposition and readmissions. Instead, Tayne et al. found that female gender, ASA class 3 or 4, and longer operative times correlated with increased readmissions.

There are limitations to our study. Two high volume surgeons at a single institute were included in this retrospective review, which may have impacted the results of our study. Studies have demonstrated that high volume surgeons have fewer readmissions, shorter LOS, and more discharges to home [36,37]. Another limitation in our study was that, although we performed a detailed chart review and history at each postoperative visit, is it possible that some readmissions to other institutions may not have been discovered. We did elicit one readmission episode to an outside facility from the patient chart and included it in our analysis.

In addition to evaluating our readmissions rate after early discharge, our study looked to identify variables that could help us identify patients more likely to discharge on postoperative day (POD) 1. Our study found certain patient characteristics to be associated with patients in the 2-day LOS cohort. Older patients and patients with a higher BMI were associated with a longer hospital stay, which is consistent with other studies [6,20–22,38,39]. A preexisting diagnosis of hypertension also correlated with longer stays. Studies have demonstrated female gender to be predictive of LOS [6,39,40]. Consistent with these findings, we observed female gender to be associated with patients in the 2-day LOS cohort. This may be because women are more likely to present for surgery later in life, with greater physical dysfunction [41,42]. Studies have also demonstrated an association between ASA score and LOS [6,38]. We could not corroborate these findings. This is likely due to differences in inclusion criteria between our studies. Husted et al. [6] reviewed a consecutive series of unselected patients, whereas our study reviewed a consecutive series of patients that were discharged to home on POD 1 or 2. Patients discharged to rehabilitation, who tend to present with greater comorbidity (Table 1), were excluded from our analysis.

Literature has shown that pain, dizziness, and weakness were the cause for most (80% of patients) longer hospital stays [43]. Intensive postoperative multimodal nonopioid pain management [44], prevention of orthostatic hypertension [45], and early physiotherapy [46] help reduce postoperative pain, dizziness, and muscle weakness, respectively. Husted et al. also observed that 3% of their study patients felt insecure with an early discharge. Preoperative patient education and postoperative reassurance can help comfort this subset of patients. Organizational factors (waiting for physiotherapy or postoperative radiographs) accounted for the remainder of delays (20% of patients) in their study.

Conclusions

Enhanced recovery after surgery pathways can be updated to shorten length of stay, without adversely impacting postoperative complications or readmissions. Shorter lengths of stay may help attenuate costs associated with total joint replacements. Further study and refinement of enhanced recovery after surgery protocols may allow more patients to be safely discharged on postoperative day one.

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