

Enhanced methods fulfilling early discharge criteria for total hip and knee arthroplasty patients

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Abstract

Introduction: Enhanced recovery strategies have resulted in significant reductions in length of hospitalization and postoperative morbidity in total hip (THA) and total knee (TKA) arthroplasties. The success and safety of the arthroplasties are characterized by the establishment of evidence-based criteria, which offer safe hospitalization and postoperative care.

Aim: The objective of the present survey was to investigate components related to fast-track recovery, discharge criteria, delayed discharge, complications, and readmissions.

Materials and methods: The following methods were employed: the ASA grade, the Charlson index, the neuropathic pain (DN4) questionnaire, and the patient health (PHQ-9) questionnaire. Additionally, the study included an examination of comorbidities, hospitalization, era deliver discharge standards, and 90-day readmission. The visual analogue pain scale, complications, and demographics were also examined in the retrospective study for the research. The study was conducted from November 2017 to January 2020.

Results: Two hundred and thirty-five patients underwent TKA (n=134) and THA (n=101), the mean age was 68±8.7 years and BMI was 32.4±5.4 kg/m². On average, the patients had 1.6±1.1 comorbidities, the Charlson index was 2.4±1.3 and the ASA grade was 2.1±0.5. The exit rules were attained at 1.9±0.75 days postoperatively. However, the actual infirmary care was 3.06±1.01 days, with a waiting span of 62.5% or 1.2 days. THA succeeded in departure principles more quickly (1.8 days vs. 2 days for TKA). Sex ($p=0.04$), age ($p=0.009$), and the Charlson index ($p=0.046$) were strongly related to the instant to fulfil the release norm in the TKA. While in THA, the length of ward stay was statistically significant and correlated with both age ($p=0.05$) and the Charlson index ($p=0.05$). In addition, the superPATH approach had a strong effect on the consummation of the delivery measures (1.48 days vs. 1.89 days for the Hardinge approach) ($p=0.002$) and shorter treatment ($p=0.04$).

Conclusion: Achieving safe release goals and reducing hospitalization were associated with modifiable (superPATH approach) and unmodifiable (age, sex, and Charlson index) foretold agents. These indexes could offer reproducible results with limitation of postoperative complications, morbidity, and readmissions.

Keywords

total hip arthroplasty, total knee arthroplasty, discharge criteria, length of stay, enhance recovery, fast track

Introduction

The contemporary escalation on the amounts of total hip (THAs) and knee arthroplasties (TKAs) has necessitated the establishment of accelerated recovery regimens to limit complications, morbidity, readmissions, as well as the cost.^[1] The favorable outcomes of the protocols are underlined by evidence based confirmed elements.^[2]

Several fast-track protocols adopt prognostic parts that would secure actual term of recovery and a postoperative phase with limited adverse events.^[3,4] Moreover, the discharge principles are composed of the above aspects and are associated with the patient, surgery, and local logistics or traditions.^[5,6] However, there are not many widely recognized guidelines that include a delivery point of reference for the best orthopedic practice when performing major joint arthroplasties.^[6] The extant literature does not elucidate well the reasons why patients who have undergone total joint arthroplasty (TJA) are discharged on a schedule that is later than expected despite having achieved their release goals.^[7]

Aim

This study primarily examines the infirmity period and the achievement of discharge criteria in patients undergoing THA or TKA. Secondly, characteristics associated with the difference between discharge goals and actual discharge home were identified. Finally, an attempt was made to explain why the patients were not ultimately discharged despite meeting the requirements for discharge.

Materials and methods

The present study was retrospective by using data which was prospectively collected for the local registry (from November 2017 to January 2020). The study was approved by the Ethics and Scientific Committee of the institution and adhered to the Declaration of Helsinki.^[8] Written consent was obtained from all patients after they were informed about their inclusion in the study.

The inclusion criteria of the patients were: (a) primary osteoarthritis of the hip or knee; (b) patients that underwent TKA with the same or similar surgical approach and surgical technique (median parapatellar) by two experienced orthopedic surgeons (G.I.D. and A.V.); (c) patients that underwent THA using a lateral (Hardinge) approach or a supercapsular percutaneously assisted total hip (Super-Path) approach by G.I.D. Finally, the study did not exclude patients and included all those that were involved in the fast-track program.

Perioperative collected data included demographic data, the American Society of Anesthesiology physical status classification system (ASA grade)^[9], the Charlson comorbidity index^[10], patient health questionnaire (PHQ-9)^[11],

douleur neuropathique 4 questions (DN4)^[12], comorbidities, surgical time, hospital length of stay (LOS), period accomplish departure guidelines, 90-day readmissions, visual analogue scale (VAS)^[13], and complications. Following the Parvizi et al.^[14] classification, adverse events were categorized as local (major or minor) and systemic (major or minor).

All patients underwent their operations (total hip and knee replacement) on a Monday morning. Cefoxitin sodium as antibiotic prophylaxis was administered for 24 hours postoperatively and low molecular weight heparin (HXMB) was postoperatively applied to all patients. The type of anesthesia (spinal or general) was chosen by the attending anesthesiologist. The follow up was one year.

An enhanced recovery protocol was followed by all patients; it comprised a pain management protocol (PMP), blood management schedule (BMS), rehabilitation therapy management, and standard orthopedic nursing agenda. The PMP included a multimodal analgesia: (a) local infiltration analgesia (LIA) with ropivacaine 7.5 mg/dl; (b) main analgesic was paracetamol; (c) in prolonged pain etoricoxib 90 mg was administered; (d) in severe pain, rescue analgesia with intramuscular opioids and tramadol (inj sol 100 mg/2 ml) was provided.

The discharge criteria (DC) were: (a) patient apyrexial with stable hemoglobin level (>8 g/dl); (b) safe and independent mobilization (ability to get in and out of bed, ability to walk with a walking aid, and ability to sit and rise from a chair or toilet); (c) knee range of motion (ROM), > 70 degrees flexion of the knee and >30 degrees flexion of the hip; (d) sufficient oral pain treatment (VAS <5 on activity), and (e) normal wound healing (dry wound or minimal wound leakage).

The Statistical Package for Social Sciences (SPSS), version 21.0, and statistical software (SPSS, Chicago, IL) were used for statistical analysis of the data. The statistical significance was set at <0.05.

Results

A total of 235 patients who underwent a THA (n=101) or a TKA (n=134) were included in the study.

TKR patients

In TKA patients, the age was 69.6±6.9 years and the BMI was 33±5.5 kg/m². The majority of the patients were women were women (80.6%). In terms of comorbidities, the patients had an average of 1.32±0.8. As per health categorization, the mean Charlson index was 3.2±1.2 and the ASA score was 4±0.48. Analyzing the neuropathic pain, the center PQ-9 score was 2.61±3.8 and the DN4 was 1.51±1.6 (**Table 1**). Patients encountered the DC at 2±0.9 days postoperatively. Whereas the actual standard LOS was 3.12±1.3 days. In addition, a delay of 1.12±0.8 days was observed. The values of the above features are summarized in **Table 1**.

Table 1. Demographic and clinical characteristics of total knee arthroplasty patients

	Total	Correlation LOS <i>p</i> -value	Correlation Discharge criteria <i>p</i> -value	Difference LOS - DC <i>p</i> -value
Patients	134			
Age	69.6±6.9	0.09	0.09	0.45
Sex		0.42	0.04	0.25
Male	26 (19.4)			
Female	107 (80.6)			
BMI	33±5.5	0.27	0.34	0.62
ASA status	4±0.48	0.92	0.24	0.17
Charlson index	3.2±1.2	0.6	0.28	0.02
PQ-9 score	2.61±3.8	0.7	0.55	0.5
DN4	1.51±1.6	0.8	0.32	0.8
Comorbidities	1.32±0.8	0.72	0.82	0.97
LOS	3.12±1.3			
Discharge criteria	2±0.9			

LOS: length of stay; DC: discharge criteria; BMI: body mass index; ASA: American Society of Anesthesiologists; PQ-9: Patient Health Questionnaire-9; DN4: Douleur Neuropathique en 4 Questions.

The main part of patients (79.3%) carried out the DC in the 1st and 2nd postoperative day.

Regarding the demographic data, only sex affected the DC to a statistically considerable degree ($p=0.04$). However, age ($p=0.09$), BMI ($p=0.34$), ASA score ($p=0.24$), the Charlson index ($p=0.28$), PQ-9 score ($p=0.55$), DN4 ($p=0.32$), and comorbidities ($p=0.82$) were not notably correlated with the schedule of delivery rules. The Charlson score revealed a positive correlation between variation of the basis and the real

interval of therapy ($p=0.02$). A history of stroke, pulmonary illness, and heart condition also contributed to the waiting period in accordance with discharge guidelines (Fig. 1).

Multivariate linear regression analysis (Table 2) disclosed that age ($p=0.009$) and the Charlson index ($p=0.046$) were the statistically profound dependent determinants which had a unique effect on the realization of delivery specifications. The survey accentuated that the remaining parts were not statistically remarkable as independent

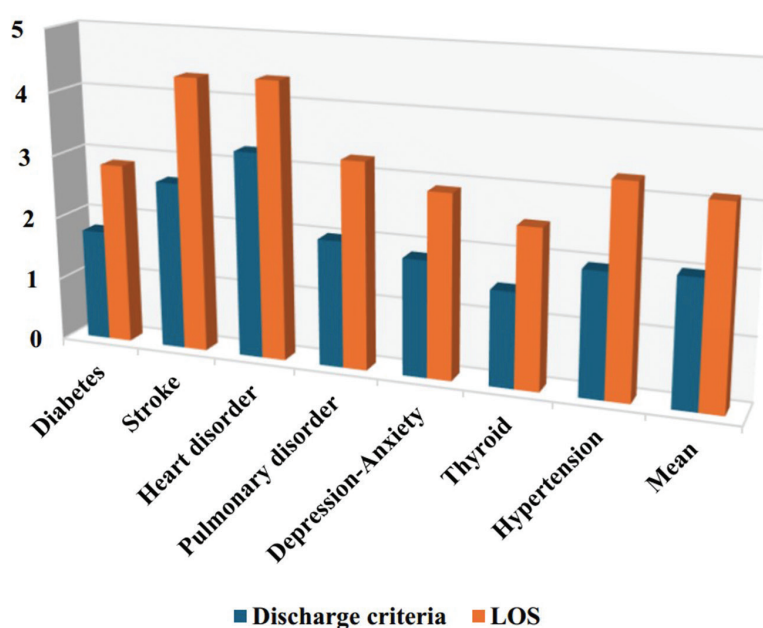


Figure 1. LOS-related comorbidities and discharge criteria in TKA.

Table 2. Independent determinants in relation to the dependent variable discharge criteria in TKR patients

Model	Unstandardized coefficients		Standardized coefficients		t-value	Sig.
	B	Std. Error	Beta			
(Constant)	0.887	1.139			0.779	0.438
Age	0.037	0.014	0.260		2.665	0.009
Gender	-0.374	0.213	-0.150		-1.756	0.081
BMI	0.005	0.017	0.027		0.283	0.777
Comorbidities	0.181	0.120	0.144		1.506	0.135
Charlson index	-0.168	0.084	-0.197		-2.011	0.046
ASA grade	-0.324	0.222	-0.155		-1.462	0.146
PQ-9	-0.013	0.022	-0.051		-0.600	0.550

TKR: total knee replacement; Std. Error: standard error; sig.: significant; BMI: body mass index; ASA: American Society of Anesthesiologists; PQ-9: Patient Health Questionnaire-9

component of treated days.

Concerning the estimation of pain, the preoperative mean pain value was 4.84 ± 2.52 (range: 7.78–1.3) and post-operatively it was 2.92 ± 1.29 (from 1.39 to 4.74).

THR patients

The THR group (n=101) had a mean age of 64.6 ± 10.4 years, and BMI was 31.4 ± 5.4 kg/m². There were more women by percentage (77.2%). Regarding the amount of comorbidities, they were 1.8 ± 1.2 . The mean Charlson index was 1.8 ± 1.3

and the ASA grade was 1.8 ± 0.6 . The Hardinge approach was applied to 73.3% of patients. Spinal anesthesia was preferred by anesthesiologists in 65.3% of this group. The patients met the DC at a midpoint of 1.8 ± 0.6 days postoperatively, whereas the LOS was found to be 3 ± 0.8 days (Table 3). In addition, the discharge delay was observed for 1.2 days and at 60%. The discharge criteria were satisfied on the 1st and 2nd postoperative days, with an entire estimation of 92.1%.

The remaining period was positively linked to the Charlson index ($p=0.05$) and the age ($p=0.05$). The Charlson index had an arithmetically constant effect on the days of accom-

Table 3. Demographic and clinical characteristics of THR patients

	Overall	Correlation LOS p-value	Correlation Discharge criteria p-value	Difference LOS - DC p-value
Patients	101			
Age	64.6 ± 10.4	0.05	0.34	0.42
Sex		0.25	0.65	0.37
Male	22			
Female	79			
BMI	31.4 ± 5.4	0.36	0.16	0.89
ASA score	1.8 ± 0.6	0.48	0.4	0.77
Charlson index	1.8 ± 1.3	0.05	0.02	0.85
Comorbidities	1.8 ± 1.2	0.9	0.93	0.86
Anesthesia		0.38	0.64	0.16
Spiral	66			
General	35			
Approach		0.6	0.002	0.04
Hardinge	74			
SuperPATH	27			
LOS (days)	3 ± 0.8			
Discharge criteria	1.8 ± 0.6			

THR: total hip replacement; LOS: length of stay; DC: discharge criteria; BMI: body mass index; ASA: American Society of Anesthesiologists; SuperPATH: supercapsular percutaneously assisted approach

plishment of the DC ($p=0.02$). In addition, patients using the superPATH approach completed discharge measures analytically significantly faster than those using the Hardinge approach (1.48 vs. 1.89 days, $p=0.002$). Furthermore, there was a numerically significant increase in the span of DC in the super PATH group (1.44 days for SuperPATH vs. 1.12 days for Hardinge) ($p=0.04$). **Table 3** summarizes these findings. In addition, pulmonary disorder, depression-anxiety, as well as history of diabetes were remarkable contributors to postponement adherence to DC (**Fig. 2**).

Multivariate linear regression examination (**Table 4**) demonstrated that the approach ($p=0.002$) was the only dependent variable statistically crucially associated with fulfillment of the discharge rules earlier as an independent determinant in patients who underwent THR.

Regarding the perioperative pain, it was 5.2 ± 2.9 (range 7.78–1.3) and postoperatively it was 1.21 ± 0.78 (limit 0.42–2.09). Patients with THR and increased pain were observed to be hospitalized for more days (≥ 4 days). Patients with spinal anesthesia experienced less pain in THR.

30 and 90-day readmissions and complication rate

Patients in the TKR group had more minor local complications ($n=9$), while the THR group had more major systemic ($n=3$) and minor systemic ($n=2$) complications. There were no patients re-admitted during the first 30 postoperative days and no deaths occurred. The above data are summarized in **Table 5**.

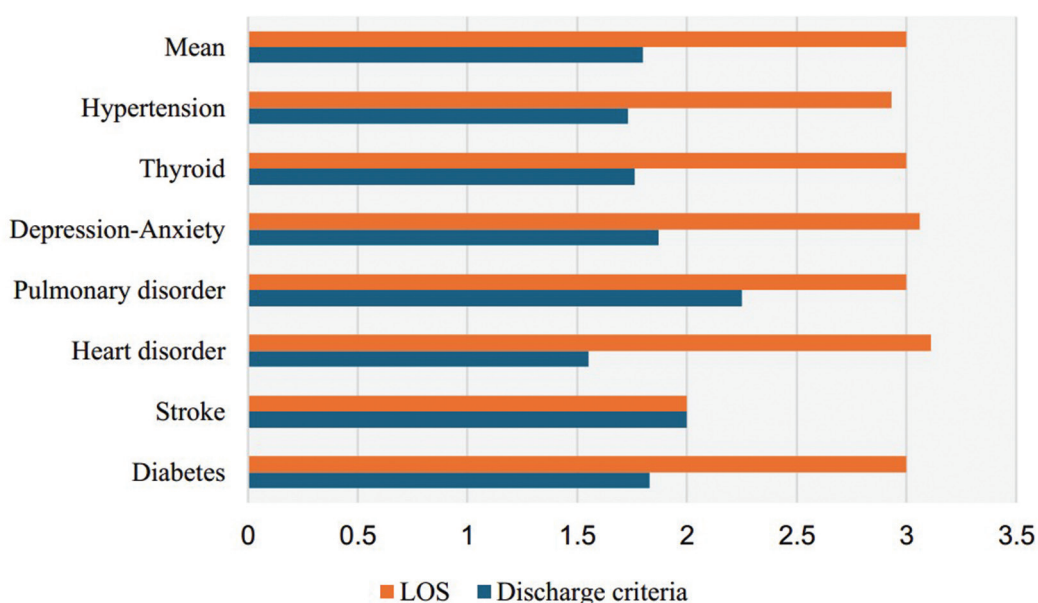


Figure 2. LOS-linked comorbidities and discharge criteria in THR.

Table 4. Independent determinants in relation to the dependent variable discharge criteria in THR patients

Model	Unstandardized coefficients		Standardized coefficients	t-value	Sig.
	B	Std. Error	Beta		
(Constant)	1.546	0.584		2.645	0.010
Age	0.012	0.007	0.208	1.720	0.089
Sex	0.065	0.143	0.046	0.456	0.649
BMI	-0.011	0.012	-0.095	-0.911	0.365
Charlson index	0.036	0.054	0.074	0.656	0.513
Anesthesia	-0.022	0.127	-0.017	-0.170	0.865
ASA grade	0.067	0.126	0.066	0.532	0.596
Approach	-0.238	0.076	-0.346	-3.142	0.002
Comorbidities	-0.071	0.069	-0.135	-1.028	0.307

THR: total hip replacement; Std. Error: standard error; sig.: significant; BMI: body mass index; ASA: American Society of Anesthesiologists

Table 5. 90-day complication rate per category

TKA		N (%)
Major systemic complications		
	Heparin induced thrombocytopenia	1
Minor systemic complications		
	Dizziness	1
Minor local complications		
	Diarrhea	1
	Hematoma	4
	Pain calf	1
	Fluid leakage	2
	Superficial infection	1
THA		N (%)
Major systemic complications		
	DVD	2
	Organic psychosis	1
Minor systemic complications		
	Allergy	1
Minor local complications		
	Hematoma	1
	Superficial infection	1

TKA: total knee arthroplasty; N: number; THA: total hip arthroplasty; DVD: deep vein thrombosis

Discussion

The results of the enhanced recovery protocol confirm the hypothesis that prognostic factors related to patients and surgery are associated with slower hospital progression and influence the timely implementation of discharge guidelines in THA and TKA. These predictor factors were sex, age, the Charlson index, and hip approach. Moreover, a difference was observed between the fulfillment of the discharge criteria and the actual date of discharge. In total joint arthroplasty, the distinction was explained by hazard factors such as comorbidities index and the superPATH approach. However, it is unclear what causes are related to the delay in exiting the institution despite the fact that the patients met the criteria. The study highlighted the indecision of the staff and the patients.

Regarding the period of being warded, the literature emphasized the distinction between actual LOS and false hospitalization.^[15] The need for short treatment forced patients to be admitted to rehabilitation or care centers rather than their homes. However, it is documented that post institution destination is not an extension of inpatient care and is strongly associated with postoperative complications and 30-day and 90-day readmissions.^[3,16] In the current survey, every patient was discharged to their home after

meeting the discharge criteria within the first two days following surgery (total 79.3% for TKA and 92.1% for THA). Thus, short hospitalization was feasible and safe.

The data regarding the discharge criteria varied across studies. The studies agreed with the presence of tolerable pain and the initiation of feeding. However, the definition of autonomous mobilization varied.^[2,6,18,19] In the contemporary investigation, adopted as a standard for safe release parts (such as mobilization, range of motion, pain, optimal Hb, and clean wood incision), which ultimately contribute to reduced readmission and limit postoperative adverse events (8.9% and 2.2% for THA and TKA, respectively).

Prolonged LOS and the accomplishment of the discharge principles in a timely manner are related to a multitude of points. Roger et al. and O'Malley et al. identified medical and surgery-related risk features, which contribute to extended hospitalization and are associated with postoperative complications and high readmission rates.^[19,20] The existing investigation showed that the early achievement of DC in THR was strongly correlated with the Charlson index ($p=0.02$) and the superPATH approach ($p=0.002$), while in TKA, it was united by sex ($p=0.04$). Additionally, by following the enhanced rehabilitation plan, TKR indicate on average higher Charlson scores (3.2 vs. 1.8), ASA (4 vs. 1.8), age (69.6 vs. 64.6 years), BMI (33 vs. 31.4 kg/m²), and twice as many systemic complications.

At the same time, an interpretation for the LOS - DC difference could focus on physician-patient uncertainty and independent figures. Regarding the independently predicted elements, in THR, as age, pain (range, 0.71–3.2 NRS) and comorbidities increased, the LOS - DC variance was raised. The use of superPATH approach reduced the time between LOS and DC ($p=0.04$). It has previously been reported that the superPATH approach can provide brief LOS^[21] and the goal of rapidly reaching delivery measures can also be achieved. Furthermore, in TKA, as age and the Charlson index escalated ($p=0.02$), the distinction between LOS and DC expanded as well.

There is a plethora of studies focusing on the positive or negative aspects of elongated LOS and readmission rates. The reason why THA and TKA patients who met the standards and were not discharged on the same day was inconclusive.^[7,17,22] Our results underlined the absence of LOS - DC discrepancy in THA in a greater percentage (9.9%) compared to TKA (4.47%). Our findings revealed that a supplementary agent allied with the LOS - DC disparity was staff and patient insecurity. Despite the wide acceptance of the criteria by the institution, even a small portion of the staff was not supported. Ultimately, patient psychology and trust were likely related to late discharge.

The present study had some limitations. As a case series, it included a relatively small number in terms of overall cases, complications, and readmissions. When divided into subgroups the significance of the statistical analysis may then be affected.

Conclusions

The enhanced recovery protocols in THA and TKA, in conjunction with the implementation of specific discharge criteria reduced the hospitalization as well as the postoperative morbidity, mortality and 30-day and 90-day readmissions. These guidelines could be reliably applied in everyday practice and enhance the orthopedic recuperation.

Additionally, feasible implementation of accelerated recovery systems depends on independent factors connected with the patient (for instance sex, age, comorbidities, and pain) and the surgery (utilization of superPATH approach). Implementation of these factors could constitute safe discharge criteria and, by extension, provide secure hospitalization and postoperative recovery. Further investigations of predicting features strongly associated with the difference between meeting discharge criteria and length of stay are required.

Declaration of competing interest

Authors declare that they have no conflict of interest.

Declaration of funding

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Declaration of ethical approval for study

The study was approved by the local Ethics and Scientific Committee of the University General Hospital of Alexandroupolis, under protocol No 838/13-09-2017. Written informed consent was obtained from all patients.

Declaration of informed consent

There is no information (names, initials, hospital identification numbers or photographs) in the submitted manuscript that can be used to identify patients.

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