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Research Article

Number of Stairs at Home Does Not Influence Discharge Disposition following Elective Total Hip Arthroplasty

Taylor Murtaugh, MD[1a], Michael B Held, MD, MBA[2b], Matthew M Levitsky, MD[3c], Richard Iorio, MD[4d], Alexander L Neuwirth, MD[2e], Jeffrey A Geller, MD[2f], H. John Cooper, MD[2g], Roshan P Shah, MD, JD[2h]

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a Taylor Murtaugh is currently an emergency medicine resident at Kings County/Downstate Medical Center. She was previously the research coordinator for the hip and knee division of orthopedics at Columbia University Medical Center.

Conflicts of Interest Statement for Taylor Murtaugh

b Dr. Held is a PGY-5 at Columbia University Medical Center. He is headed to Rothman Orthopaedics for adult reconstruction fellowship in 2023-2024.

Conflicts of Interest Statement for Dr. Held

c Dr. Levitsky is an orthopedic Surgeon with a particular interest in total hip and total knee arthroplasty.

Connect with Dr. Levitsky on LinkedIn

Conflicts of Interest Statement for Dr. Levitsky

Visit the Open Payments Data Page for Dr. Levitsky

d Dr. Richard Iorio, MD is a Reconstructive Orthopedic Surgery Specialist in Boston, MA.

Visit the Open Payments Data Page for Dr. Iorio

Conflicts of Interest Statement for Dr. Iorio

e Dr. Alexander Neuwirth is an orthopedic surgeon specializing in advanced hip and knee reconstruction, with a focus on surgical treatment of early, middle, and late-stage arthritic conditions of the hip and knee. For patients requiring surgical intervention, Dr. Neuwirth specializes in anterior approach hip replacement, knee replacements, as well as complex revision surgeries to treat failed hip and knee replacements.

Dr. Neuwirth received his medical degree from Rutgers University-Robert Wood Johnson Medical School, where he also completed his undergraduate degree. Following medical school, Dr. Neuwirth trained as a resident in orthopedic surgery at the University of Pennsylvania, where he also spent a year as a postdoctoral research fellowship in the McKay Orthopaedic Research Laboratory. Before joining the faculty at Columbia as an attending physician, Dr. Neuwirth completed a fellowship in adult hip and knee reconstruction at Columbia University Irving Medical Center.

In addition to his clinical practice, Dr. Neuwirth is actively engaged in ongoing clinical outcomes research in the field of joint replacement and reconstruction. His primary research efforts are focused on the eradication of infection following hip and knee replacements.

Visit Dr. Neuwirth's Website

Conflicts of Interest Statement for Dr. Neuwirth

Visit the Open Payments Data Page for Dr. Neuwirth

f Dr. Jeffrey Geller is an Orthopedic Surgeon in NYC, New York. He specializes in anterior hip replacement surgery and total or partial knee replacement surgery. He has been doing anterior hip replacements for more than 6 years and has extensive training and experience in the latest minimally invasive hip and knee reconstructive procedures. He also specializes in lower extremity trauma, such as hip fractures, fractures near joint replacements, and osteoporosis-related fractures.

Having completed more than 10,000 cases, Dr. Geller is among the most experienced surgeons in New York City and Westchester in anterior hip replacements and robotically assisted total or partial knee replacement. Dr. Geller is also an expert in repairing painful or poorly-functioning knee replacements and hip replacements (revision procedures).

Dr. Geller uses the most advanced minimally invasive surgical techniques. He uses smaller incisions and muscle-preserving techniques to help keep normal anatomy intact. He evaluates every case to see if a non-operative treatment option is possible. Dr. Geller's is focused on getting patients back to their normal lives as soon as possible.

Visit Dr. Geller's Professional Website

Connect with Dr. Geller on LinkedIn

Visit the Open Payments Data Page for Dr. Geller

Conflicts of Interest Statement for Dr. Geller

g Dr. Cooper is an associate professor of orthopedic surgery at Columbia University Irving Medical Center in New York City, with a busy clinical practice focusing on anterior approach hip arthroplasty, robotic knee arthroplasty, and complex revision surgery. An active educator and researcher, he has published over 125 peer-reviewed articles and book chapters. Originally from South Carolina, Dr. Cooper graduated from Duke University with a degree in mechanical engineering and materials science, then completed medical education at Columbia University, residency at Lenox Hill, and fellowship at Rush University Medical Center.

Visit Dr. Cooper's profile on Columbia Orthopedics' Website

[1] Kings County/Downstate Medical Center, [2] Columbia University Medical Center, [3] OrthoCarolina, [4] Brigham and Women's Hospital

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Background

Pragmatic challenges of the patient's home environment, specifically the number of stairs (NOS) required to enter or navigate a patient's home may influence discharge destination (DD) and length of stay (LOS) following primary Total Hip Arthroplasty (THA).

Questions/purposes

This study investigates whether the NOS at home predicts discharge to a post-acute-care-facility (PACF) following THA.

Methods

548 consecutive THA patients at a single urban arthroplasty center between 2011-2014 were reviewed. Patient factors including age, sex, BMI, length of stay, operative time, Anesthesia Score Assessment (ASA), the Risk-Assessment-and-Prediction-Tool (RAPT) and NOS stairs were analyzed. Logistic regression was performed to identify predictors for disposition to PACF. Groups were cohorted by number of stairs, and incidence of PACF discharge was determined.

Results

238 (43.4%) patients were discharged to PACF. The NOS at home had no impact on discharge to PACF (OR 1.02, 95% CI .993-1.04, p=0.209). Older age (OR 1.09, 95% 1.07-1.10, p<0.0001), LOS (OR 1.23, 95% 1.08-1.39, p=0.001), higher ASA (OR 1.74, 95% 1.19-2.53, p=0.004), and lower RAPT score (OR 0.0.865, 95% 0.781-0.958, p=0.005) were significant predictors for disposition to PACF (p<0.005). Female sex was protective in discharge to PACF (OR 0.391, 95% 0.260-0.587, p<0.0001). The incidence of PACF discharge was similar between groups of unavoidable stairs at home.

Conclusion

The NOS at home did not influence discharge destination following THA. This retrospective study helps discharge planning and in setting expectations for patients undergoing THA by supporting a home discharge in the setting of unavoidable stairs.

INTRODUCTION

Since 2016, Centers for Medicare and Medicaid Services (CMS) have mandated the use bundling programs in certain regions of the country with the goal of reducing cost of a total joint episode of care. The financial and outcome-improvement incentives set up by these programs, which include the Comprehensive Care for Joint Replacement (CJR) Model and the Bundled Payment for Care Improvement (BPCI) initiative, encourage discharge to home rather than

Connect with Dr. Cooper on LinkedIn

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h Roshan P. Shah, MD, JD, specializes in hip and knee reconstruction using minimally invasive techniques for less pain and faster recovery times. He believes there are many valuable pain-relieving treatments that do not involve surgery. When an operation is needed, he embraces careful surgical techniques with attention to the biological, anatomical, and mechanical restoration that is critical for a pain-free return of function.

Visit Dr. Shah's profile on Columbia Orthopedics' Website

Visit the Open Payments Data Page for Dr. Shah

Conflicts of Interest Statement for Dr. Shah

a post-acute care facility (PACF) by way of indirect financial incentives, primarily to the hospitals. Post-acute care accounts for 36%-55% of the total cost associated with an episode of care, with discharge disposition to rehabilitation facilities being the driver (Bozic et al. 2014; Dobson et al. 2012). It is estimated that $1.82 billion is spent annually on rehabilitation at post-acute care facilities after total hip or knee arthroplasty (Harada et al. 2000; Mallinson et al. 2011; Tian et al. 2012).

A number of factors have been well-documented to predict likelihood of disposition to PACF, including older age, higher American Society of Anesthesiologists class (ASA), Medicare insurance, female sex, slower pre-operative timed-get-up-and-go test (TGUG), lower EQ-5D, living alone, increased length of hospital stay (LOS), increased postoperative pain on postoperative day (POD) 1 and 2, and decreased distance walked on POD 1 (Oldmeadow, McBurney, and Robertson 2003; Wang et al. 1998). Yet to the best of our knowledge no studies have previously looked at pragmatic challenges of the patient's home environment, specifically the number of stairs required to enter or navigate the patient's home. For example, an otherwise healthy patient living on the 6th floor of a building without an elevator faces an onerous obstacle to home discharge, which may strongly influence likelihood of discharge to PACF. The influence of this type of living environment may be regional, but there are no current stratifications by CMS or by common predictive tools to account for the number of stairs at home. The Risk Assessment and Predictor Tool (RAPT) is predictive of discharge disposition but does not consider the number of stairs at home (Oldmeadow, McBurney, and Robertson 2003). It considers age, gender, walking distance, gait aids, community supports, and living with someone who can provide care after surgery. Other scoring systems for total hip and knee arthroplasty also predict discharge disposition but insufficiently address the effect of the number of stairs at home (Bindelglass et al. 1999; Wang et al. 1998).

In this case-controlled study, we analyzed risk factors for disposition to PACF following elective total hip arthroplasty (THA), focusing on the number of stairs at home in an urban population. We hypothesized that an increasing number of stairs at home is a risk factor for discharge to PACF.

MATERIAL AND METHODS

We retrospectively evaluated 562 consecutive patients who underwent primary, elective THA at a single urban academic medical center between November 2011 and October 2014. Fourteen patients were excluded due to incomplete records, leaving 548 patients. Patients were grouped into those going home with home services (n=310, 56.6%) and those going to PACF (n=238, 43.4%).

Patient demographics and other factors are shown in Table 1, including sex, age, body mass index (BMI), Anesthesia Score Assessment (ASA), the Risk Assessment and Prediction Tool (RAPT), number of unavoidable stairs at home, tranexamic acid status (TXA), operative time, length of hospital stay (LOS), and discharge destination. All the cases were performed by two senior fellowship-trained arthroplasty surgeons through a mini-posterior approach. This study was approved by our institutional review board (IRB).

All surgeries were performed prior to implementation CJR or BPCI at our institution. Nonetheless, all patients received preoperative education and were provided standard educational materials about their surgery from the same pre-operative educator. Physical therapy goals and discharge plans were discussed pre-operatively. Following surgery, physical therapy was administered twice a day and occupational therapy once a day. Social workers began disposition planning on POD 1 and made arrangements based on physical therapy reports and suitability of the home environment, including consideration of the number of unavoidable stairs at home. Patients in the home-group were provided home care services including physical therapy and visiting nursing.

Descriptive statistical analyses were performed for baseline demographic data. A paired Student's t-test was used for continuous factors and chi-square test or Fisher's exact test were used for categorical variables. Data were subjected to univariate analysis between discharge status and one patient related factor at a time. The factors with $p<0.05$ were included in the logistical regression model to identify factors predicting discharge to PACF. Variables included age, sex, LOS, ASA, and RAPT. The number of unavoidable stairs in the home did not have a p-value of less than 0.05 in univariate analysis, but was included in the logistical regression as it was the variable of interest in this study.

Finally, we stratified the cohort into three groups based on the number of stairs (0, 1-10, and greater than 10) to de-

termine the incidence of PACF discharge and used the incidence to perform a retrospective power analysis. Demographic data are given in Table 3. All statistical analyses were performed by using SPSS version 24.0 (SPSS, Chicago, IL).

RESULTS

Of the 548 patients, 310 (56.6%) were discharged directly home with home-care services, while 238 (43.4%) were discharged to PACF. The PACF group was older, more female, and had a higher ASA score. Mean number of unavoidable stairs were 7.3 ± 9.8 stairs. 182 patients reported no stairs in their home, while 183 patients reported having greater than 10 stairs necessary to negotiate upon returning home.

RAPT scores did not correlate with the presence of unavoidable stairs at home. Patients without stairs had an average RAPT of 9.4 ± 2.0 and those with stairs had an average RAPT of 9.4 ± 2.2 (p=0.96). RAPT scores less than 6 predict discharge to a PACF, and scores over 9 predict discharge home. Scores between 6 and 9 indicate an intermediate risk of PACF discharge, but can lead to home discharge if home services or another intervention is made. RAPT predicted discharge to a PACF, but not at scores below 6. The average RAPT for patients going home was 9.9 ± 2.0 compared to 8.7 ± 2.2 for those going to PACF (p<0.001).

On univariate analysis, five variables were significantly associated with discharge to PACFs following THA, including increasing age, female sex, longer LOS, higher ASA, and lower RAPT score (all p<0.001). BMI (p=0.477), TXA status (p=0.869), number of stairs (p=0.749), and operative time (p=0.864) were not found to influence discharge disposition.

All the above significant variables on univariate analysis were included in the logistic regression model, and all were found to be independently significant (Table 2). Older age, longer LOS, higher ASA, and lower RAPT score increased the risk for discharge to PACF and female sex decreased the risk.

182 patients reported no stairs, 195 patients reported 1-10 stairs, and 171 patients reported >10 stairs (Table 3). There were fewer women with unavoidable stairs, but otherwise there were no significant differences in demographics between groups.

We found that 45.6% (83), 38.5% (75) and 46.2% (79) patients were discharged to PACFs in the no stairs, 1-10 stairs and >10 stairs groups respectively (Table 4). There was no significant difference between no stairs and 1-10 stairs group for discharge destination, (p=0.18). Also, there were no significant differences between the no stairs and >10 stairs groups (p=1.0), nor between the 1-10 stairs and >10 stairs groups for discharge destination (p=0.17). With similar incidences between groups, a post-hoc power analysis found a beta of 0.845 to detect a difference between > 10 stairs and <=10 stairs.. A fully powered study would have 10x the number of subjects in each group.

DISCUSSION

Age, BMI, female sex, length of hospital stay, ASA grade, and TKA are known predictive factors of discharge disposition site after total joint arthroplasty (Aggarwal et al. 2013; Barsoum et al. 2010; Bindelglass et al. 1999; Bozic et al. 2006; Oldmeadow, McBurney, and Robertson 2003; Pablo et al. 2004; Wang et al. 1998). Similar to some of the existing literature, our study confirmed age, LOS, ASA grade, and lower RAPT scores were predictive of an increased likelihood for discharge to PACF. Our data also identified female gender as being protective against discharge to PACF following THA. This current study did not suggest the number of unavoidable stairs at home was a risk factor for discharge disposition to PACF following THA, with numbers available. This rejects our hypothesis and is important for discharge planning and properly setting patient expectations.

There has been heightened focus on discharge disposition following TJA, spurred by policy initiatives from CMS addressing the cost of this procedure. Post-acute care can be accountable for greater than 50% of an episode of TJA cost, and this part of an episode of care had historically received the least attention from the surgeon. PACFs are responsible for a large portion of this post-acute care cost. It has been estimated that discharge to SNF costs almost twice the cost of the implant and is 7.5 times the cost of outpatient rehabilitation (Bogasky et al. 2008; Kremers et al. 2014). Additionally, discharge to these post-acute care facilities may be associated with inferior outcomes (Keswani et al. 2016). Bini et al. found that patients discharged to SNF had higher readmission rates when compared to home discharge for THA (5.2% vs 2.4%, p<0.001). Another study by Ramos et al. found that 30-day readmission rate were significantly higher in patients to IRF vs SNF and home (5.1% vs 1.4% and 1.5%, p=0.002). Finally, Keswani et al. showed a 5.0% unplanned 30-day readmission rate for non-home discharge patients vs 2.8% for those discharged home (p<0.001). Therefore, home discharge is preferred whenever safe.

Our population from 2011 to 2014 was chosen to precede the more modern push to discharge patients home, and to avoid the confounding effects of bundled care. Examining this population allowed for a less biased analysis of the ef-

Table 1. Demographics based upon discharge deposition.

Demographics	Home (n=310)	PACF (n=238)	P-value
Age (±SD, range)	61.8 (±14.0, 16-88)	73.8 (±11.6, 19-96)	<0.0001*
Sex (% Females)	136 (43.9%)	160 (67.2%)	<0.0001*
BMI (±SD, range)	27.4 (±5.9, 15.1-66.7)	27.8 (±6.2, 14.9-54.8)	0.48
ASA (±SD, range)	2.2 (±0.5, 1-3)	2.5 (±0.6, 1-4)	<0.0001*
RAPT (±SD, range)	9.9 (±2.0, 3-12)	8.7 (±2.2, 2-12)	<0.0001*
LOS (±SD, range)	3.4 (±2.3, 0.3-30.0)	4.3 (±2.8, 1.6-33.4)	<0.0001*
Tranexamic Acid (% Yes)	158 (51.0%)	123 (51.7%)	0.93
Operative Time (±SD, range)	96.6 (±20.9, 58-177)	96.1 (±30.4, 26-329)	0.86
Number of stairs at home	7.5 (±9.8, 0-73)	7.2 (±9.9, 0-72)	0.75

* denotes significance.

Table 2. Logistic Regression. Predictors of discharge to PACFs.

				95% CI	
Variable	Std. Err.	p-value	Odds ratio	Lower	Upper
Sex(female)	0.208	<0.0001*	0.391	0.260	0.587
Age	0.010	<0.0001*	1.082	1.062	1.103
LOS	0.064	0.001*	1.229	1.083	1.394
Stairs	0.010	0.209	1.013	0.993	1.033
ASA	0.193	0.004*	1.735	1.188	2.534
RAPT	0.052	0.005*	0.865	0.781	0.958

* denotes significance.

Table 3. Demographics based upon number of unavoidable stairs.

Demographics	No Stairs (n=182)	**p-value**	1-10 Stairs (n=195)	**p-value**	>10 Stairs (n=171)	**p-value**
Age (±SD, range)	67.6 (±15.7, 17-96)	**0.91**	67.8 (±12.3, 21-93)	**0.09**	65.4 (±14.8, 16-94)	**0.17**
Sex (% Females)	109 (59.9%)	**0.68**	112 (57.4%)	**0.01***	75 (43.9%)	**0.003***
BMI (±SD, range)	27.0 (±6.1, 14.9-55.0)	**0.15**	28.0 (±6.3, 15.7-66.7)	**0.76**	27.8 (±5.8, 17.5-50.1)	**0.25**
ASA (±SD, range)	2.3 (±0.6, 1-4)	**0.44**	2.4 (±0.5, 1-3)	**0.09**	2.3 (±0.6, 1-4)	**0.38**
RAPT (±SD, range)	8.5 (±2.2, 2-12)	**<0.0001***	9.5 (±2.2, 3-12)	**0.0005***	10.2 (±0.1.7, 5-12)	**<0.0001***
LOS (±SD, range)	4.1 (±3.6, 0.3-33.4)	**0.03***	3.5 (±1.6, 1.3-11.3)	**0.27**	3.7 (±1.9, 0.5-18.8)	**0.16**
Unavoidable Stairs	0	**<0.0001***	4.5 (±2.3, 1-10)	**<0.0001***	18.4 (±10.6, 11-73)	**<0.0001***

* denotes significance.

fect of unavoidable stairs on home discharge after THA. A more modern population would be subject to the influence of surgeon and hospital staff encouraging home discharge.

RAPT scores below 6 predict discharge to a PACF and scores between 6 and 9 have an intermediate risk of going to PACF. Discharge location was predictable by RAPT score for our cohorts, but the difference in score was small (a difference of 1.2 on the scale) and the average RAPT for discharge to PACF was high at 8.7. Other factors, therefore, predict the number of patients going to PACF in our study, including the time period studied (when there was a lower bar to PACF discharge), anxiety of family members, and less evolved surgical technique and pain protocols. The number of stairs at home would be expected to affect these other

Table 4. Discharge Disposition by the Number of Unavoidable Stairs.

Discharge Destination	No Stairs (n=182)	p-value	1-10 Stairs (n=195)	p-value	>10 Stairs (n=171)	p-value
PACF (%)	83 (45.6%)	**0.17**	75 (38.5%)	**0.14**	79 (46.2%)	**1.0**

factors, by increasing patient and family member anxiety, influencing hospital-based physical therapist recommendations for discharge, and raising concerns of social workers. Nonetheless, our study did not find the number of unavoidable stairs at home to be a significant factor influencing discharge to PACF after THA.

Our secondary findings are consistent other studies investigating associations with discharge disposition. Bozic et al. used a stepwise logistic regression analysis model separately for THA and TKA patients and found that older age, female sex, ASA, Medicare insurance, and site of service were associated with higher likelihood of being discharged to an extended care facility in a total of 7,818 patients after TJA (including both primary and revision TKA and THA). They reported that 29% of TKA and 29% of THA patients were discharged to an extended care facility. Munin et al. used a logistic regression model analysis to identify risk factors that were predictive of disposition to an inpatient rehabilitation unit in 163 patients who underwent primary hip and knee arthroplasty. They reported that 40% of the patients were discharged to the inpatient rehabilitation, and that these patients live alone, are older in age and have increased comorbid conditions and more pain in comparison to patients who went home. Forrest et al (1998; 1999) in two different studies found that older age, diabetes mellitus, living alone and ASA classification were the various risk factors that were associated with discharge disposition to rehabilitation center. Pablo et al. found that older age, obesity and living alone were significant predictors of discharge to a rehabilitation facility after primary THA. They also found that for both primary and revision THA, the most important predictor of discharge to a rehabilitation facility was worse functional status before discharge. In summary all these studies consistently identified that age, female sex, social support, measures of comorbidity, type of surgery and obesity were the predictors of discharge to rehabilitation facilities.

Our study confirms the importance of age, ASA, and length of hospital stay as predictors of discharge to PACFs. Our study differs from the literature in regards to female sex as a predictor for discharge to PACFs in finding it to be a protective factor decreasing the odds of going to PACF by approximately 60%. Unlike the cited literature though, our cohort only contains primary THA, while the literature showing increased risk of discharge to PACF with female sex included primary and revision THA and TKA (Barsoum et al. 2010; Bozic et al. 2006; Keswani et al. 2016). The limited literature confined to risk factors associated with discharge to PACF in the setting of primary THA did not find sex to be a significant risk factor only citing older age, obesity, and living alone as significant predictors to discharge to PACF (Bozic et al. 2006). Recovery after THA is distinctly different from recovery after TKA, and investigations into discharge disposition should distinguish the two procedures. To our knowledge, no other study in the past has examined the number of unavoidable stairs at patient's home as a risk factor for discharge to PACF.

There are certain limitations of this study. First, this study was performed at a single, high-volume academic center in an urban area, potentially limiting its generalizability to other hospitals or areas of the country. A multicenter study would be a better study to validate our findings. Second, the retrospective nature of our study design caries inherent limitations. No *a priori* power analysis was performed since the effect size of stairs was unknown. Using the incidences found in this study, a post-hoc power analysis showed power of 15.5% and that 10x the subjects would be needed to achieve >80% power. Nonetheless, the similar incidences between groups supports our findings that unavoidable stairs do not clearly impact discharge destination. Finally, this study investigates the number of *unavoidable* stairs at home, but may have some loss of data integrity if patients misunderstood this question and included avoidable stairs.

The number of unavoidable stairs at home was not a significant barrier to discharge to home post total hip arthroplasty and did not predict discharge to PACF. This finding is helpful for discharge planning, and more importantly, for setting expectations for THA patients to help many prepare for a home discharge even if they have unavoidable stairs to

navigate at home. This study further supports the literature that increased age, length of stay, and ASA are associated with discharge to PACF.

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