Oregon Health & Science University
School of Medicine

Scholarly Projects Final Report

Title *(Must match poster title; include key words in the title to improve electronic search capabilities.)*

Effects of Delayed Postoperative Void and Preoperative Urologic Symptoms on Delay in Time of Discharge for Elective Lumbar Decompression Surgery

- Title is slightly different from the poster as this is the manuscript title and it was too long for the poster. This was discussed with and approved by Dr. Lisa Silbert.

Student Investigator's Name

Jason Brant

Date of Submission *(mm/dd/yyyy)*

03/15/2022

Graduation Year

2022

Project Course *(Indicate whether the project was conducted in the Scholarly Projects Curriculum; Physician Scientist Experience; Combined Degree Program [MD/MPH, MD/PhD]; or other course.)*

This project was conducted in the Scholarly Projects Curriculum.

Co-Investigators *(Names, departments; institution if not OHSU)*

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Scholarly Project Final Report

Concentration Lead's Name

Dr. Lisa Silbert

Project/Research Question

To investigate the association between preoperative lower urinary tract symptoms (LUTS) and time to first postoperative void among patients undergoing elective lumbar decompression surgery. Additionally, we looked for an association between time to first void (TFV) and time to discharge. We hypothesized that patients with LUTS would have an increased TFV, which would in turn be associated with a longer time to discharge.

Type of Project *(Best description of your project; e.g., research study, quality improvement project, engineering project, etc.)*

Clinical Research Study

Key words *(4-10 words describing key aspects of your project)*

Lower urinary tract symptoms; international prostate symptom score; IPSS; voiding; elective; spine surgery; lumbar decompression.

Meeting Presentations

If your project was presented at a meeting besides the OHSU Capstone, please provide the meeting(s) name, location, date, and presentation format below (poster vs. podium presentation or other).

Publications *(Abstract, article, other)*

If your project was published, please provide reference(s) below in JAMA style.

Brant JE, Smith S, Radoslovich SS, Wyland A, Walker JR, Lieberman EG, Yoo JU. Effects of delayed postoperative void and preoperative urologic symptoms on delay in time of discharge for elective lumbar decompression surgery. *Spine J.* 2021 Dec 25:S1529-9430(21)01095-0. doi: 10.1016/j.spinee.2021.12.012. Epub ahead of print. PMID: 34963631.

Submission to Archive

Final reports will be archived in a central library to benefit other students and colleagues. Describe any restrictions below (e.g., hold until publication of article on a specific date).

As this article was recently published in The Spine Journal, there is a 12-month embargo period. The paper/data presented in this report should be restricted to members of OHSU only and not open to the general public until March 2023. This scholarly project submission is the preprint version of the article and it should be linked to the published article using its DOI, which I will provide before the introduction below.

Scholarly Project Final Report

Next Steps
What are possible next steps that would build upon the results of this project? Could any data or tools resulting from the project have the potential to be used to answer new research questions by future medical students?

To build on the results of this project, a prospective cohort study can be designed to determine if limiting postoperative TFV to ≤ 4 hours results in an earlier discharge. The dataset used for my scholarly project is a large dataset and we are already using it to answer other questions such as the following: is preoperative opioid use associated with higher preoperative LUTS scores? The medical students that helped me with this project can continue research on this patient sample to answer any other questions they may have.

Please follow the link below and complete the archival process for your Project in addition to submitting your final report.

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Student's Signature/Date *(Electronic signatures on this form are acceptable.)*
This report describes work that I conducted in the Scholarly Projects Curriculum or alternative academic program at the OHSU School of Medicine. By typing my signature below, I attest to its authenticity and originality and agree to submit it to the Archive.

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Mentor's Approval *(Signature/date)*

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Mentor Name

Scholarly Project Final Report

Report*: Information in the report should be consistent with the poster, but could include additional material. Insert text in the following sections targeting 1500-3000 words overall; include key figures and tables. Use Calibri 11-point font, single spaced and 1-inch margin; follow JAMA style conventions as detailed in the full instructions.*

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Brant JE, Smith S, Radoslovich SS, Wyland A, Walker JR, Lieberman EG, Yoo JU. Effects of delayed postoperative void and preoperative urologic symptoms on delay in time of discharge for elective lumbar decompression surgery. *Spine J.* 2021 Dec 25:S1529-9430(21)01095-0. doi: 10.1016/j.spinee.2021.12.012. Epub ahead of print. PMID: 34963631.

To find the most up-to-date version of this study, the published article can be accessed by its DOI in https format below:
https://doi.org/10.1016/j.spinee.2021.12.012

Introduction *(≥250 words)*

Lower urinary tract symptoms (LUTS) are common, increase with age, and consist of voiding and storage difficulties [1, 2]. These symptoms affect both men and women and can negatively impact patient mental health, quality of life, and ability to perform activities of daily living [3-5]. LUTS can be identified using validated questionnaires and the presence of these symptoms could indicate underlying urinary dysfunction [1, 5]. The severity and prevalence of LUTS can be estimated with the widely used International Prostate Symptom Score (IPSS), a seven-item questionnaire with an additional question on quality of life attributable to urinary symptoms. It is based on the American Urological Association-Symptom Index for benign prostatic hyperplasia (BPH), which has been validated for LUTS assessment and quantification of urinary bother in both men and women [2, 6-12]. Research has shown the prevalence of preoperative LUTS in patients undergoing elective lumbar spine surgery to be 46% [13]. To our knowledge, no study has examined whether preoperative LUTS affect a patient's time to first spontaneous void after lumbar spine surgery.

Members of the American Society of Anesthesiologists agree that routine monitoring of urinary voiding should be done during the postoperative period [14]. Therefore, institutions often employ a bladder management protocol to assess patient voiding and address complications such as postoperative urinary retention (POUR) [15]. However, the expected time to first void (TFV) varies between institutions and providers, often ranging from 4-6 hours after surgery [16, 17]. The decision to intervene on patients who have a prolonged TFV is also highly variable. Some protocols recommend catheterizing patients who do not void within 4-8 hours following surgery or based on bladder scan measurements [16-18]. Though, use of catheterization for an inability to void after lumbar spine surgery has been shown to be associated with an increased length of stay (LOS) [17, 19].

The LOS for patients undergoing lumbar decompression surgery has decreased in recent years. Prior studies have shown that appropriately selected patients can safely undergo lumbar decompression surgery as an outpatient while maintaining low readmission rates [17, 20, 21]. Limiting LOS in patients undergoing lumbar decompression surgery is a crucial component in decreasing cost. Longer LOS for lumbar laminectomy surgery is associated with an increased average cost from $6,742 to $15,443 for a LOS of 2 and > 5 days, respectively [22]. Further, during the COVID 19 pandemic it has become essential to perform elective surgeries as outpatient or at ambulatory surgery centers, when possible, in order to preserve hospital bed inventory [23]. Thus, it is necessary to identify and mitigate any modifiable risk factors such as postoperative voiding that may delay patient discharge.

The primary aim of this study was to investigate the association between preoperative LUTS and TFV among patients undergoing elective lumbar decompression surgery. Additionally, we looked for an association between TFV and time to discharge; we hypothesized that patients with LUTS would have an increased TFV which would in turn be associated with a longer time to discharge.

Methods *(≥250 words)*

Institutional review board approval was obtained before beginning this study and all patients were provided with informed consent prior to participating. All patients ≥ 18 years of age undergoing a planned elective lumbar spinal decompression surgery with one of three orthopaedic spine surgeons at a single academic medical center from July 2017 to March 2020 were invited to participate in this study. A retrospective cohort analysis of prospectively collected clinical data was performed on this patient sample.

Exclusion criteria included non-English speaking as a primary language, pregnant, and incarcerated patients. Additionally, patients who did not complete a preoperative IPSS, did not undergo surgery, underwent two separate spine surgeries during the same admission, had a previously placed ureteral stent, had no documented first void data, or had an initial postoperative void recorded > 24 hours after anesthesia stop time were excluded from this study. Demographic data including age, sex, race, and ethnicity were documented. Patient history and symptoms as documented by the surgeon in preoperative clinic notes were collected through a review of patient electronic medical records.

The IPSS survey was completed by patients at their preoperative visit as a clinical standard of care. This survey consists of seven questions quantifying urinary symptoms of storage (frequency, urgency, and nocturia) and voiding (incomplete emptying, intermittency, weak stream, and straining) [24]. Per IPSS guidelines, each question is scored on a scale of 0 to 5 ranging from symptoms occurring “not at all” to “almost always” within the past month [12]. The final IPSS score is the sum of the seven questions with the presence of clinically relevant LUTS being defined as a score of ≥ 8 points. LUTS severity is further categorized as IPSS scores of mild (0-7), moderate (8-19), and severe (20-35) [4, 12, 24].

Patients underwent surgery as planned in a hospital setting. Intraoperative data was collected from patient electronic medical records including type of decompression surgery and intraoperative Foley catheter use. Time from anesthesia stop to first void (TFV) and time from anesthesia stop to discharge were recorded.

According to our institutional postoperative voiding protocol, patients are encouraged to void within 4 hours after their preoperative void or within 4 hours after Foley removal if an intraoperative catheter was used. Thus, prolonged TFV was defined as a first postoperative void of > 4 hours. Patients were divided into two groups based on TFV; ≤ 4 hours and > 4 hours after anesthesia stop time. It is standard of care at our institution to attempt patient discharge within 24 hours after lumbar decompression surgery. Therefore, a prolonged discharge time was defined as a discharge time of > 24 hours. Patients were divided into two groups based on time after anesthesia stop to discharge, ≤ 24 hours and > 24 hours. This categorization addresses the variability in surgery time of day in that all patients had the same amount of time after surgery end to be discharged for both morning and afternoon surgeries.

The association between preoperative LUTS and TFV of > 4 hours and between TFV of > 4 hours and discharge time of > 24 hours were estimated with risk ratios (RR) and 95% confidence intervals (CI) using multivariable Poisson regression models with robust error variances adjusted for possible confounding factors including age (≤ and > 60 years), sex, intraoperative Foley catheter use, and IPSS. Confounders were identified by variables that altered the RR by ≥ 10%. P values ≤ 0.05 were considered to be statistically significant.

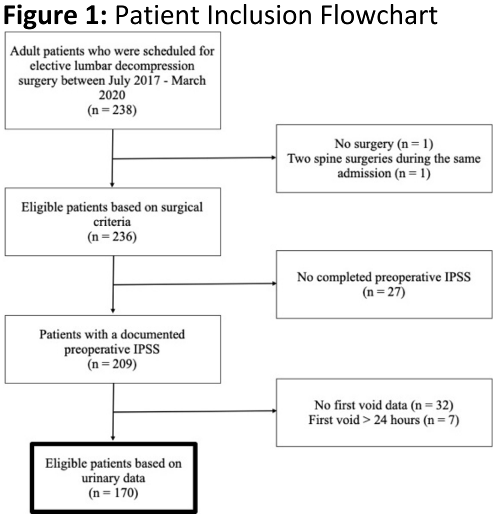
Theory/calculation

LUTS are subjective symptoms that could indicate certain pathological conditions such as urine outflow obstruction or detrusor overactivity if a symptom type (e.g., storage, voiding) is the predominant reported symptom [1]. Patients with preoperative urinary dysfunction could be at an increased risk of developing postoperative urinary difficulties if an already altered voiding pathway is further affected by surgical processes. Medications (e.g., diazepam, propofol, isoflurane) used in surgery can reduce or suppress detrusor contractions and intrathecal anesthetics block both afferent and efferent signals innervating the bladder, which suppresses the urgency to void [25]. Additionally, patients with lumbar spine pathology (spinal stenosis, disc herniation) are likely to have appreciable urinary dysfunction and/or neuropathic bladder as demonstrated by urodynamic studies [26]. Therefore, preoperative urinary dysfunction in lumbar spine surgery patients could affect their ability to void postoperatively, which would hinder their ability to discharge until spontaneous voiding resumes.

Results *(≥500 words)*

There were 238 patients who met initial inclusion criteria during the study period. After applying exclusion criteria, 170 patients (71%) were included in the final study cohort (Figure 1).

Figure 1: Patient Inclusion Flowchart



The mean (standard deviation) age of the study sample was 60.4 (13.9) and 53.8 (15.1) years among men and women, respectively. Of the 170 included patients, 61% were men and 39% were women.

Demographics, relevant spine symptoms, and intra- and postoperative data for the study sample are displayed in Table 1.

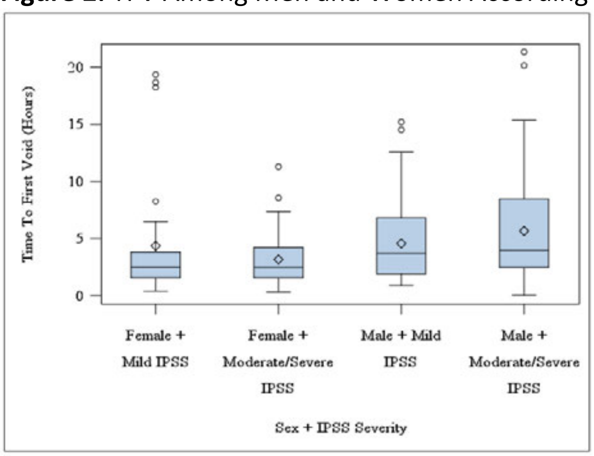
Table 1 Patient Baseline Characteristics

	Combined	Men			Women		
Characteristic	**Total n = 170**	**Total n = 103**	**Mild n = 63 (61%)**	**Moderate/Severe n = 40 (39%)**	**Total n = 67**	**Mild n = 31 (46%)**	**Moderate/Severe n = 36 (54%)**
Age (Years)							
Mean (SD)	57.3 (14.8)	60.4 (13.9)	56.7 (16.6)	54.4 (17.8)	53.8 (15.1)	53.3 (15.5)	52.9 (16.3)
Range	21 - 84	26 - 84	18 - 86	18 - 86	21 - 74	20 - 78	20 - 78
Time to First Void (Hours)							
Mean (SD)	4.5 (4.2)	5.7 (5.2)	5.0 (4.2)	4.6 (3.5)	3.2 (2.3)	3.7 (3.9)	4.4 (5.2)
Range	0 - 21	0 - 21	0 - 21	1 - 15.2	0 - 11	0 - 19	0 - 19.4
Length of Stay (Days)							
Mean (SD)	1.3 (1.4)	1.3 (1.1)	1.0 (0.9)	0.9 (0.7)	1.3 (1.6)	1.1 (1.4)	1.0 (1.1)
Range	0 - 7	0 - 5	0 - 5	0 - 3.0	0 - 7	0 - 7	0 - 4.0
Race							
Non-White	10	7	3 (5%)	4 (10%)	3	2 (7%)	1 (3%)
White	153	92	57 (95%)	35 (90%)	61	28 (93%)	33 (97%)
Ethnicity							
Hispanic	3	2	2 (3%)	0 (0%)	1	0 (0%)	1 (3%)
Non-Hispanic	163	98	59 (97%)	39 (100%)	65	31 (100%)	34 (97%)
Axial Pain							
No	140	87	54 (90%)	33 (92%)	53	24 (89%)	29 (88%)
Yes	16	9	6 (10%)	3 (8%)	7	3 (11%)	4 (12%)
Radiculopathy							
No	27	20	11 (18%)	9 (25%)	7	1 (4%)	6 (18%)
Yes	129	76	49 (82%)	27 (75%)	53	26 (96%)	27 (82%)
Claudication							
No	115	64	43 (72%)	21 (58%)	51	25 (93%)	26 (79%)
Yes	41	32	17 (28%)	15 (42%)	9	2 (7%)	7 (21%)
Previous Spine Surgery							
No	105	57	36 (59%)	21 (52%)	48	21 (70%)	27 (75%)
Yes	62	44	25 (41%)	19 (48%)	18	9 (30%)	9 (25%)
Decompression Procedure							
Discectomy	69	41	27 (43%)	14 (35%)	28	13 (42%)	15 (42%)
Laminectomy	76	50	29 (46%)	21 (52%)	26	12 (39%)	14 (39%)
Laminotomy	21	8	6 (10%)	2 (5%)	13	6 (19%)	7 (19%)
Foraminotomy	3	3	0 (0%)	3 (8%)	0	0 (0%)	0 (0%)
Interlaminar Decompression	1	1	1 (2%)	0 (0%)	0	0 (0%)	0 (0%)
Year of Surgery							
2017	33	23	12 (19%)	11 (28%)	10	3 (10%)	7 (19%)
2018	60	29	17 (27%)	12 (30%)	31	14 (45%)	17 (47%)
2019	57	35	22 (35%)	13 (32%)	22	14 (45%)	8 (22%)
2020	20	16	12 (19%)	4 (10%)	4	0 (0%)	4 (11%)
IO Foley							
No	143	85	53 (84%)	32 (80%)	58	24 (77%)	34 (94%)
Yes	27	18	10 (16%)	8 (20%)	9	7 (23%)	2 (6%)

SD – standard deviation
IO – intraoperative

Distribution of TFV according to LUTS status and sex is shown in Figure 2.

Figure 2: TFV Among Men and Women According to LUTS Status



Mean TFV was 5.0 hours and 3.7 hours among men and women, respectively. 111 (65%) of 170 patients voided within 4 hours after surgery. The prevalence of clinically relevant preoperative LUTS was 39% and 54% among men and women, respectively. 30 of 94 (32%) patients without preoperative LUTS and 29 (38%) of patients with preoperative LUTS had a first void of > 4 hours (Table 2).

Table 2 Preoperative LUTS Versus TFV

Characteristic	Total n = 170	First Void ≤ 4 Hours n = 111 (65%)	First Void > 4 Hours n = 59 (35%)
Combined			
Pre-Op IPSS Severity			
Mild	94	64 (68%)	30 (32%)
Moderate/Severe	76	47 (62%)	29 (38%)
Men			
Pre-Op IPSS Severity			
Mild	63	38 (60%)	25 (40%)
Moderate/Severe	40	21 (52%)	19 (48%)
Women			
Pre-Op IPSS Severity			
Mild	31	26 (84%)	5 (16%)
Moderate/Severe	36	26 (72%)	10 (28%)

Pre-Op – preoperative

There was no association between preoperative LUTS and TFV. The unadjusted RR for a TFV of > 4 hours due to preoperative LUTS was 1.04 (95% CI: 0.82-1.32) (*P* = 0.77) for men and women combined. Adjusting for age, sex, and intraoperative Foley use did not materially alter the RR. The adjusted RR for men and women combined was 1.10 (95% CI: 0.87-1.39) (*P* = 0.42) (Table 3).

Table 3 Risk of Initial Postoperative Void > 4 Hours for Patients with Preoperative LUTS

RR (95% CI)	Combined	Men	Women
Unadjusted	1 04 (0 82 - 1 32)	1 11 (0 76 - 1 63)	1 07 (0 81 - 1 42)
P	0 77	0 59	0 62
Adjusted for Age	1 02 (0 81 - 1 29)	1 05 (0 72 - 1 53)	1 07 (0 81 - 1 42)
P	0 87	0 80	0 62
Adjusted for IO Foley	1 06 (0 84 - 1 34)	1 10 (0 75 - 1 60)	1 17 (0 90 - 1 51)
P	0 64	0 63	0 24
Adjusted for Age, Sex, and IO Foley	1 10 (0 87 - 1 39)	N/A	N/A
P	0 42		

RR – risk ratio
CI – confidence interval
IO – intraoperative

Of the 59 patients with a TFV of > 4 hours, 37 (63%) were discharged after 24 hours. Separating by sex, the ratios were similar. 64% of men and 60% of women with a TFV of > 4 hours were discharged > 24 hours after anesthesia stop time (Table 4).

Table 4 TFV Versus Time to Discharge

Characteristic	Total n = 170	Discharged ≤ 24 Hours n = 99 (58%)	Discharged > 24 Hours n = 71 (42%)
Combined			
Time to First Void			
First void ≤ 4 hours	111	77 (69%)	34 (31%)
First void > 4 hours	59	22 (37%)	37 (63%)
Men			
Time to First Void			
First void ≤ 4 hours	59	41 (69%)	18 (31%)
First void > 4 hours	44	16 (36%)	28 (64%)
Women			
Time to First Void			
First void ≤ 4 hours	52	36 (69%)	16 (31%)
First void > 4 hours	15	6 (40%)	9 (60%)

The unadjusted RR for a discharge of > 24 hours among all patients with a TFV of > 4 hours was 2.17 (95% CI: 1.51-3.10) (*P* < 0.001). Age and intraoperative Foley catheter use were the only confounding factors found to be statistically significant in our model. After adjusting for age, sex, intraoperative Foley catheter use, and IPSS, the RR was 1.77 (95% CI: 1.25-2.51) (*P* = 0.001). Separating by sex, the unadjusted RR was 2.24 (95% CI: 1.46-3.43) (*P* < 0.001) and 2.04 (95% CI: 1.05-3.97) (*P* = 0.04) among men and women, respectively. Age was a confounding factor for men and intraoperative Foley catheter use was a confounding factor for both men and women. Adjusting for age, intraoperative Foley catheter use, and IPSS resulted in a RR of 1.76 (95% CI: 1.17-2.66) (*P* = 0.007) among men and 1.58 (95% CI: 0.85-2.94) (*P* = 0.15) among women (Table 5).

Table 5 Risk of Discharge > 24 Hours with a TFV of > 4 hours

RR (95% CI)	Combined	Men	Women
Unadjusted	2 17 (1 51 - 3 10)	2 24 (1 46 - 3 43)	2 04 (1 05 - 3 97)
P	< 0 001	< 0 001	0 04
Adjusted for Age	1 97 (1 38 - 2 83)	1 86 (1 21 - 2 85)	2 02 (1 04 - 3 95)
P	< 0 001	0 004	0 04
Adjusted for Sex	2 18 (1 51 - 3 13)	N/A	N/A
P	< 0 001		
Adjusted for IO Foley	1 95 (1 37 - 2 76)	2 09 (1 37 - 3 18)	1 66 (0 89 - 3 09)
P	< 0 001	0 001	0 11
Adjusted for Age, IO Foley, and IPSS	1 78 (1 26 - 2 51)	1 76 (1 17 - 2 66)	1 58 (0 85 - 2 94)
P	0 001	0 007	0 15
Adjusted for Age, Sex, IO Foley, and IPSS	1 77 (1 25 - 2 51)	N/A	N/A
P	0 001		

RR – risk ratio
CI – confidence interval
IO – intraoperative

Discussion *(≥500 words)*

Preoperative LUTS may be associated with postoperative voiding difficulties, which can lead to increased LOS following surgery. In this study, we did not find an association between preoperative LUTS and postoperative TFV in men and women undergoing elective lumbar spinal decompression surgery in a hospital setting. Similar to previous research [13], the overall prevalence of preoperative LUTS in this patient sample was 45%. There was a notable difference of preoperative LUTS prevalence between sex as 39% of men and 54% of women were affected by these symptoms. Reported LUTS prevalence between men and women varies with studies showing one sex having a higher prevalence than the other or no difference between the two [2, 4, 13]. Women are at 50% increased odds of developing LUTS, possibly due to the fluctuation of symptoms across the female lifespan as a result of events such as childbirth and menopause [27]. This could explain the higher prevalence of LUTS in women seen in our patient sample. It could also be explained by differences in perceived self-reporting of symptoms between sexes or in difficulties accurately capturing chronic symptoms of LUTS at a single time point by survey.

This study found an association between delayed TFV and length of hospital stay. It has been shown that men are at an increased risk of voiding difficulties after several different orthopaedic surgeries including spine (cervical, lumbar) and lower extremity total joint arthroplasty (hip, knee) [19, 28-31]. Consistent with previous studies, our research showed that men had a higher incidence of a prolonged TFV after surgery (43%) when compared to women (22%). However, for both men and women, preoperative LUTS did not affect the time to first postoperative void. It is important to monitor patient postoperative voiding because impaired return of bladder function can lead to complications and a longer hospital stay [17]. One study showed that among patients undergoing outpatient total hip arthroplasty, 27% of patients stayed overnight for medical observation due to urinary retention. Additionally, preoperative urinary frequency and BPH are two comorbidities associated with an increased risk of requiring an overnight stay after hip replacement [32].

In our study, men were at a significantly 76% higher risk of being discharged > 24 hours after surgery if their first postoperative void was > 4 hours. Even though this relationship was not statistically significant for women after adjusting for several variables, the ratio of women with a TFV of > 4 hours and a discharge of > 24 hours mirrored that of men (~60%). Additionally, when men and women were combined for analysis, sex was not a confounding factor. Therefore, a larger sample size would likely result in a significant RR for women similar to that of men. This association of initial postoperative void and discharge is important because 1) we found that a cutoff of 4 hours can be used to predict an increased risk of prolonged stay and 2) there are potentially modifiable factors to improve TFV after surgery.

Prompt postoperative voiding does not have to be accomplished using invasive means such as catheterization. Use of alpha-blockers (tamsulosin, prazosin), avoiding morphine in regional anesthetics, and early postoperative mobilization are effective methods for preventing urinary retention [33]. Administration of alpha-blockers 6-24 hours before surgery has been shown to reduce the risk of urinary retention requiring catheterization [34]. Thus, preoperative alpha-blocker administration could be used to encourage early postoperative voiding. Additionally, applying hot packs or gauze warmed in water to the suprapubic region is an effective treatment option to facilitate urinary voiding with a number needed to treat of 2 [33]. Of patients who had an intraoperative Foley catheter placed for surgery, this catheter should be removed at specific times to promote early discharge. A systematic review showed that removing an indwelling catheter either at midnight or shortly after surgery resulted in a decreased LOS. However, removing an indwelling catheter at midnight resulted in a longer TFV [35]. Therefore, removal of an intraoperative Foley catheter immediately after lumbar decompression surgery could result in earlier return of urinary function and decreased LOS.

A prolonged LOS results in filled hospital beds that are unavailable for future patients, which lowers the department's potential surgical volume and is especially relevant after the COVID 19 pandemic when hospitals are still recovering from extreme over-capacity. Additionally, the hospital is not ideal for long-term recovery and a patient's ability to return home should be maximized. Preoperative counseling before hip and knee arthroplasty has been shown to reduce patient stress and result in a significantly shorter LOS [36]. Similar education on the importance of early voiding after spine surgery could help patients develop a better understanding of possible outcomes and ways to optimize their hospital stay. One study showed that difficulties urinating after lumbar spine surgery was associated with decreased patient satisfaction for up to two years after surgery [29]. This emphasizes that return of urinary function after surgery affects patients in both the short- and long-term. Theoretically, if TFV is shortened to ≤ 4 hours, then LOS could decrease; however, future studies are required to determine this effect.

There were some limitations to this study. First, this was a retrospective study in its design, which is vulnerable to confounding. Collection of information on all eligible patients was attempted to mitigate selection bias, though patients without a preoperatively completed IPSS were excluded, which would most likely underestimate the prevalence of preoperative LUTS. Factors that could affect postoperative voiding such as a history of BPH or urinary retention, amount of intravenous fluid administration, and longer operation time were also not included in this study. However, lumbar decompression surgeries are generally shorter surgeries, which minimizes the effect of operation time and intravenous fluid administration on postoperative voiding. Additionally, IPSS survey responses provide a quantitative description on voiding difficulties that would not be available with only a BPH diagnosis. Second, patients without a documented first postoperative void were not included in this study. However, all but two of these patients were discharged ≤ 24 hours after surgery, which if presumed to have normal postoperative voiding, the inclusion of these patients in the analysis would further strengthen the association between first postoperative void and discharge time. Third, this analysis was performed on a small sample size. Larger studies with the inclusion of relevant urinary confounding factors that could affect postoperative voiding are necessary.

The patient sample in this study was from one academic institution and was comprised of mostly white individuals, which may limit the generalizability of these results. Therefore, our results may not be accordant with hospitals in other geographical locations and community practices. However, we argue that the results of this study are applicable to orthopaedic surgeries requiring general anesthesia. One study showed that when compared to other major orthopaedic surgeries, joint arthroplasty was associated with a higher risk of postoperative voiding difficulty [30]. Additionally, surgical factors such as general anesthesia and opioids can interrupt the micturition pathway [25]. Thus, a patient's ability to void postoperatively is relevant to several different types of surgeries.

Conclusions *(2-3 summary sentences)*

Although we hypothesized that the patients with preoperative urologic symptoms would have greater postoperative urologic difficulty, we did not find this to be true. However, we did find that for men undergoing lumbar decompression surgery, a TFV of > 4 hours is significantly associated with a prolonged time to discharge. Strategies to improving the first void time may have significant benefit to both patient satisfaction and lowering the cost of care for patients undergoing lumbar decompression surgery.

References *(JAMA style format)*

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