

Association Between Operative Day of the Week and Postoperative Outcomes Following Lumbar Fusion

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Abstract

Purpose:

We aimed to further characterize the correlation between surgical day of the week and post-operative outcomes following lumbar fusion surgery.

Methods:

This was a retrospective electronic medical record (EMR) analysis of adult patients (> 18 years) that underwent elective level 1–3 lumbar fusions at a large, tertiary academic institution between 2022 and 2025. Trauma, tumors, and emergent cases were excluded. Patient demographics, social determinants of health (SDOH), operative characteristics, and post-operative outcome variables were collected from EMRs and surgeon follow-up notes. Statistical significance was assessed using Chi-square and Student's T-tests. Univariate linear regression evaluated correlations between surgical day and operative variables.

Results:

A total of 617 patients met inclusion criteria. Friday operations had shorter operative lengths ($p = 0.002$), increased intra-operative transfusions ($p = 0.008$), decreased risk of prolonged length of stay ($p = 0.018$), and lower likelihood of 90-day ER admissions ($p = 0.004$). Monday operations had greater risk of 90-day readmissions ($p = 0.016$) and ER admissions ($p = 0.030$). Both Monday and Friday ER admissions, along with Monday hospital readmissions, remained significant after controlling for surgeon variability with multivariate regression.

Conclusions:

Attenuations of Friday correlations after regression suggests that surgical and postoperative differences experience greater influence from surgeon-specific factors than surgical timing. While most demographic characteristics did not significantly differ among operative days, Friday operations were correlated with greater patient social vulnerability compared with Monday-Thursday patient cohorts. The increased risk of 90-day ER admissions and hospital readmissions for Monday operations and decreased ER admission risk for Friday operations may reflect additional factors such as discharge timing or access to outpatient care rather than surgical timing.

Introduction

The prevalence of lumbar fusion surgery has significantly increased in recent years with the frequency of single level fusion procedures expected to double by 2050 and multilevel fusions by 2040¹. As the

incidence of lumbar fusion procedures continues to increase, spinal surgery research has expanded to compare surgical techniques to improve clinical outcomes and gain a better understanding of surgical, perioperative, and patient-specific factors that may optimize surgical outcomes². Despite many advances, lumbar fusion surgery carries significant risks including infection, reoperation, and complications such as thromboembolism or neurologic injury³. Identification of modifiable risk factors for lumbar fusion surgery can help to prioritize patient health, decrease recovery times, and reduce postoperative complications and overall healthcare costs.

The timing of surgery within the week is one such variable that has previously been shown to have an impact on surgical outcomes. Many studies have illustrated that patients who undergo general surgical procedures immediately before the weekend or during the weekend carry greater risk of post-operative complications, experience prolonged hospital stays, and higher rates of mortality, a phenomenon commonly referred to as the “weekend effect”^{4,5}. Similarly, in patients undergoing elective cervical spine procedures, patients admitted during the weekend or immediately pre-weekend had higher rates of both 30 day and 90 day readmissions compared to those treated during the weekdays⁶.

Prior publications focusing solely on the “weekend effect” in lumbar fusion surgeries have reported that late week surgeries have significantly higher costs, 30-day readmissions, longer lengths of stay, and hours of physical therapy compared to early week surgeries^{7,8}. The aim of this retrospective analysis was to examine the impact of surgical day of the week on post-operative outcomes following lumbar fusion surgery in a multimorbid patient population. Through this research, we hope to elucidate opportunities to improve surgical outcomes through optimization of scheduling practices.

Methods

This was a retrospective cohort study of patients that underwent elective 1–3 level lumbar fusion procedures at a large, tertiary academic medical institution between 2022 to 2025. All patients were over 18 years of age and received elective lumbar fusion procedures with a minimum of six months of follow-up. Patients were excluded if they were under 18 years old or received emergency treatment; patients undergoing lumbar fusion procedures as a result of tumor or trauma were also excluded.

Variables were collected retrospectively from patient electronic medical records (EMR). Information on patient demographics, such as age, sex, body mass index (BMI), primary language, insurance status, and race was obtained. Intra-operative and post-operative characteristics, such as date of operation, occurrence of intra-operative complications, hospital length of stay, and readmissions were also determined from patient EMRs. Surgical approach and the occurrence of post-operative pain were assessed via surgeons’ post-operative follow-up notes.

Statistical analysis was performed using IBM SPSS Statistics, Version 30.0 (IBM Corp., Armonk, New York, USA). Chi square test of independence and Fisher’s exact test were used to perform univariate analysis to determine statistical significance between the day of operation, patient demographics, and

operative characteristics. Independent sample T-tests were used to determine significance between day of operation and variables such as age, BMI, length of operation, and hospital length of stay. Binary logistic and multivariate linear regression analyses were performed to analyze significant correlations with the day of the week on which an operation was performed.

Results

A total of 617 patients met the inclusion criteria for this retrospective study. There were 447 patients (72.4%) who received operations between Monday and Thursday, and 170 patients (27.6%) who received Friday operations. No significant differences in age, sex, primary language, race, nor insurance status were determined between the Monday through Thursday cohort versus the Friday cohort (Table 1). Patients who received operations on Friday had significantly lower BMIs compared to patients who underwent lumbar fusions Monday through Thursday ($p = 0.043$). Surgical approach was significantly associated with the operative day; open approaches comprised a higher percentage of surgical approaches on Fridays (65.8%) compared to open approaches on other weekdays (51.6%) ($p = < 0.001$). Patients who received Friday operations were significantly more likely to suffer SDOH disparities in all areas compared to patients who underwent fusion surgery between Monday and Thursday (Table 2).

Table 1
Patient Demographics

Characteristics	Monday-Thursday	Friday	P-value
N (%)	447 (72.4%)	170 (27.6%)	--
Age (mean, SD)	62.6, 12.0	62.4, 12.1	0.843
Sex (%)			0.441
<i>Male</i>	154 (34.5%)	53 (31.2%)	--
<i>Female</i>	293 (65.5%)	117 (68.8%)	--
BMI (mean, SD)	31.5, 5.4	30.5, 5.6	0.043
Primary language			0.079
<i>English</i>	329 (73.6%)	113 (66.5%)	--
<i>Non-English</i>	118 (26.4%)	57 (33.5%)	--
Insurance status			--
<i>Medicaid</i>	145 (32.4%)	58 (34.1%)	0.692
<i>Medicare</i>	242 (54.1%)	95 (55.9%)	0.698
<i>Commercial</i>	60 (13.5%)	17 (10.0%)	0.247
Race			0.270
<i>White</i>	64 (14.3%)	16 (9.4%)	--
<i>Black or African American</i>	142 (31.8%)	54 (31.8%)	--
<i>Indian</i>	10 (2.2%)	2 (1.2%)	--
<i>Asian</i>	9 (2.0%)	1 (0.6%)	--
<i>Other</i>	220 (49.3%)	97 (57.1%)	--
Surgical Approach			< 0.001
<i>Open</i>	210 (47.0%)	109 (64.1%)	--
<i>MIS Posterior</i>	162 (36.2%)	21 (12.4%)	--
<i>MIS Anterior</i>	75 (16.8%)	40 (23.5%)	--

Table 2
Social Determinants of Health

SDOH Factors	Monday-Thursday	Friday	P-value
Food Insecurity			0.002
<i>Low Risk</i>	327 (50.5%)	112 (65.5%)	--
<i>High Risk</i>	32 (4.9%)	11 (6.4%)	--
Utilities			< 0.001
<i>Low Risk</i>	328 (50.7%)	117 (68.4%)	--
<i>High Risk</i>	21 (3.2%)	2 (1.2%)	--
Transportation			< 0.001
<i>Low Risk</i>	362 (56.0%)	124 (72.5%)	--
<i>High Risk</i>	21 (3.2%)	8 (4.7%)	--
Financial Resource Strain			< 0.001
<i>Low Risk</i>	331 (51.2%)	120 (70.2%)	--
<i>High Risk</i>	19 (2.9%)	2 (1.2%)	--
Caring for Others			0.002
<i>Low Risk</i>	340 (52.6%)	116 (67.8%)	--
<i>High Risk</i>	9 (1.4%)	2 (1.2%)	--
Exposure to Violence			< 0.001
<i>Low Risk</i>	340 (52.6%)	117 (68.4%)	--
<i>High Risk</i>	3 (0.5%)	0 (0.0%)	--
Housing Stability			< 0.001
<i>Low Risk</i>	319 (49.3%)	116 (67.8%)	--
<i>High Risk</i>	26 (4.0%)	5 (2.9%)	--
Inadequate Housing			< 0.001
<i>Low Risk</i>	334 (51.6%)	119 (69.6%)	--
<i>High Risk</i>	16 (2.5%)	2 (1.2%)	--

Operative characteristics, including number of fusion levels and occurrence of post-op radicular pain, demonstrated no significant differences between patients who received operations between Monday through Thursday versus Friday (Table 3). Intra-operative complications, along with rates of revision

surgery, 90-day return to the OR, and 90-day readmissions, also showed no significant differences between the cohorts (Table 3).

Table 3
Friday Operative Characteristics

Characteristics	Monday-Thursday	Friday	P-value
Number of Levels (mean, SD)			0.436
<i>One</i>	256 (57.5%)	101 (59.4%)	--
<i>Two</i>	139 (31.2%)	48 (28.2%)	--
<i>Three</i>	49 (11.0%)	19 (11.2%)	--
Operative Duration (min) (mean, SD)	281.4, 115.6	249.5, 109.4	0.002
Hospital Length of Stay (days) (mean, SD)	5.0, 3.8	4.4, 2.9	0.084
Prolonged Length of Stay	143 (31.8%)	38 (22.2%)	0.018
ICU Post-Op	18 (4.0%)	11 (6.5%)	0.204
Postop Radicular Pain	119 (26.6%)	39 (23.1%)	0.369
Any Intra-op Complication	27 (6.0%)	12 (7.0%)	0.645
Intra-op Transfusion	3 (0.7%)	6 (3.5%)	0.008
< 90 Day Return to OR	19 (4.3%)	4 (2.4%)	0.261
< 90 Day Readmission	52 (11.7%)	16 (9.4%)	0.421
< 90 Day ER	105 (23.6%)	22 (12.9%)	0.004
Revision Surgery	23 (5.2%)	9 (5.3%)	0.950

Analysis of operative duration revealed that patients who received lumbar fusion procedures on Fridays had significantly faster operations (249.5 mins vs. 281.4 mins, $p = 0.002$). Friday patients experienced prolonged lengths of stay, defined as a post-operative stay of longer than six days, significantly less frequently (22.2% vs. 31.8%, $p = 0.018$). Furthermore, intraoperative transfusions were more likely to occur in Friday patients (3.5% vs. 0.7%, $p = 0.008$), but they were also significantly less likely to be readmitted to the ER within 90 days following surgery (12.9% vs. 23.6%, $p = 0.004$) (Table 3). Multivariate linear regression and binary logistic regression showed that, when age, sex, BMI, number of fusion levels, and operating surgeon were controlled for, operative duration, intra-operative transfusions, and prolonged length of stay were no longer statistically significant for Friday versus the rest of the week. However, multivariate regression analysis also illustrated that Friday still had significantly lower rates of 90-day ER admissions compared to the remainder of the week (OR 0.390; 95% CI 0.228–0.671; $p < 0.001$).

Additionally, statistical analysis comparing patients who received Monday operations versus procedures in the remainder of the week showed that Monday patients were significantly more likely to have 90-day readmissions (16.3% vs. 9.3%, $p = 0.016$) and 90-day ER admissions (26.8% vs. 18.6%, $p = 0.030$) (Table 4). Multivariate regression analysis demonstrated that, when controlling for age, sex, BMI, number of fusion levels, and operating surgeon, Monday patients were still significantly more likely to be admitting to the ER within 90 days following surgery (OR 2.155; 95% CI 1.259–3.688; $p = 0.005$) and more likely to experience 90-day hospital readmissions (OR 2.074; 95% CI 1.064–4.045; $p = 0.031$).

Table 4
Monday Operative Characteristics

Characteristics	Monday	Tuesday-Friday	P-value
Number of Levels (mean, SD)			0.080
<i>One</i>	96 (62.7%)	261 (56.5%)	--
<i>Two</i>	48 (31.4%)	139 (30.1%)	--
<i>Three</i>	9 (5.9%)	59 (12.8%)	--
Operative Duration (min) (mean, SD)	257.5, 116.2	277.6, 114.0	0.060
Hospital Length of Stay (days) (mean, SD)	4.8, 3.8	4.8, 3.6	0.849
Prolonged Length of Stay	40 (25.8%)	141 (30.3%)	0.284
ICU Post-Op	4 (2.6%)	25 (5.4%)	0.157
Postop Radicular Pain	33 (21.4%)	125 (27.1%)	0.166
Any Intra-op Complication	12 (7.7%)	27 (5.8%)	0.390
Intra-op Transfusion	1 (0.7%)	8 (1.7%)	0.336
< 90 Day Return to OR	9 (5.9%)	14 (3.0%)	0.104
< 90 Day Readmission	25 (16.3%)	43 (9.3%)	0.016
< 90 Day ER	41 (26.8%)	86 (18.6%)	0.030
Revision Surgery	10 (6.5%)	22 (4.8%)	0.392

Discussion

In this retrospective study, we aimed to characterize the effect of surgical day of the week on post-operative outcomes within a cohort of 617 patients. There were no significant differences in demographic factors nor operative factors including post-op radicular pain, intra-operative complications, 90-day return to OR, 90-day readmission, or revision surgery between Friday patients and Monday-Thursday patients. Patients who underwent Friday operations had significantly greater socioeconomic vulnerability in all SDOH domains compared with patients undergoing surgery between

Monday and Thursday. Friday operations were correlated with fewer ER admissions within 90 days post-operatively, decreased likelihood of prolonged hospital stays, shorter operation lengths, and higher risk for intraoperative transfusion compared to patients who received procedures Monday through Thursday. However, apart from ER admissions, these differences no longer remained significant after controlling for demographic factors and surgeon variability. Patients who received Monday operations, compared to patients who received operations Tuesday through Friday, were significantly more likely to experience ER admissions and readmissions within 90 days, a correlation not attenuated by controlling for surgeon variability and patient demographic characteristics.

Patient-Level Characteristics

While there is significant literature detailing correlations between patient demographics and SDOH characteristics with perioperative outcomes, there is limited information connecting the patient variability with outcomes compared among operative days. Our findings from this study illustrated that there were no significant relationships between patient demographic variables, such as age, sex, language status, race, and insurance status, and surgical day of the week. In contrast, patients undergoing Friday operations had significantly lower BMIs and were at significantly increased odds of experiencing adverse SDOH characteristics compared with patients undergoing procedures Monday through Thursday. These findings suggest that Friday patients represent a socioeconomically more vulnerable population, highlighting the importance of considering social risk factors when evaluating the associations between operative timing and perioperative outcomes; differences attributed to operative day of the week may be confounded by or reflective of underlying disparities in patient populations.

Friday Operations

In contrast with previous lumbar fusion studies, our study suggested that Friday operations within our patient population had improved patient outcomes, defined by reduced 90-day ER rates, along with shorter operation times and decreased risk of prolonged length of stay. This result is particularly surprising in the context of a multimorbid patient population and the significantly greater burden of adverse SDOH among Friday patients. In addition, Friday patients had a higher percentage of open surgery, which we initially expected to affect length of stay and readmission rates. The association between Friday operations and increased risk of intraoperative transfusion supports prior studies that have postulated that pre-weekend operations carry greater risk for intraoperative complications and adverse post-operative outcomes^{7,8}. The use of multivariate linear regression eliminated significant associations between these variables and surgical day of the week, suggesting that surgeon variability significantly accounts for differences in perioperative outcomes throughout the week. This finding is supported by a wide variety of prior studies that suggest that surgeon specific factors such as age, differing surgical technique practices and preferences, operating schedule, and experience influence operative characteristics and patient post-operative health outcomes^{9,10,11,12}. Consequently, our findings suggest that Friday's decreased operation length, decreased prolonged stays, and greater intraoperative

transfusions were more likely due to surgeon-specific factors rather than characteristics of individual surgical days of the week.

ER and Hospital Admissions

Our findings illustrated that Monday operations were associated with significantly greater likelihoods of readmissions and ER admissions within 90 days following surgery; this finding contrasts with prior research that has demonstrated that Monday operations are associated with the lowest rates of post-operative morbidity and mortality^{4,13}. Additionally, even after controlling for surgeon variability and other confounding variables with multivariate linear regression, patients who received Monday operations remained significantly more likely to experience ER admissions and hospital readmissions within 90-days post-operatively. Similarly, even after regression analysis, Friday operations remained correlated with a decreased risk of 90-day ER admissions. The lack of attenuation of these associations by controlling for surgeon variability suggests that, rather than being influenced by surgeon-specific characteristics, ER and hospital readmissions are likely influenced by additional factors such as discharge timing, discharge facility, access to outpatient care, and other complex socioeconomic and psychosocial variables. Similarly, prior studies have stated that patients who had Friday operations received weekend post-operative care significantly more often than patients who had Monday operations¹⁴. Consequently, Friday patients who received post-operative care over the weekend and were subsequently discharged during the week would have greater access to outpatient services; in comparison, Monday patients may be more likely to be discharged pre-weekend and therefore, for any medical concerns, would need to seek care at the ER rather than outpatient locations which are commonly closed over weekends. In our patient cohort, the average hospital length of stay following lumbar fusion surgery was 4.82 days; this suggests that Friday patients would receive weekend post-operative care and would be discharged early in the following week whereas Monday patients would receive post-operative care throughout the week and be discharged immediately pre-weekend. This discrepancy in discharge timing could possibly explain the increased ER and hospital readmission rates for Monday patients and decreased rates for Friday patients as shown in this study.

Furthermore, many studies have emphasized ER visits as a marker for the level of accessibility to medical services in a given population; often, ER overcrowding and higher frequencies of ER visits can represent patient inability to consistently access outpatient and primary care services^{15,16}. Our patient cohort is especially unique in that over 90% of our patients utilize government-funded insurance, representing the socioeconomic disparities in our population. This vulnerability may further compound variations in discharge timing, explaining the increased rates of ER visits for Monday patients compared to Friday patients.

Strengths

This study sought to better characterize the relationship between operational day of the week and perioperative outcomes. The strengths of this study include a large cohort of 617 patients, providing statistical power to identify significant correlations. All patient demographics and operative characteristics are regularly documented in patient EMRs as part of regular clinical care. Our study is generalizable and carries external validity for other populations as all of our patients received standard clinical and surgical care. Finally, the utilization of binary logistic and multivariate linear regression allowed for control of confounding factors and more targeted analysis of surgical day of week associations.

Limitations

These findings should be interpreted with careful consideration of the limitations of this study. Although surgeon variability was controlled for with multivariate linear regression analysis, additional confounding factors may still exist as a result of individual surgeon technical proficiencies, surgeon operating day preferences, and staff scheduling practices. Additionally, although SDOH characteristics and frequency of ER visits are a well-known proxy for accessibility to outpatient care services, outpatient access is not explicitly measured on SDOH questionnaires and clinical questioning about access to care is not part of the standardized practice. The single-centered nature of this study may limit its variability despite the large size of our cohort. Also, as this is a retrospective study, causation cannot be determined.

Conclusions

In this retrospective cohort of patients undergoing lumbar fusion surgery, surgical day of the week was associated with select perioperative outcomes. The attenuation of many observed differences after controlling for demographic factors and surgeon variability highlights the significant influence of individual surgeon characteristics on patients' intraoperative journeys and post-operative outcomes. Although Friday operations were not associated with increased adverse outcomes, patients who received Friday operations demonstrated greater social risk burden compared with patients undergoing surgery earlier in the week, emphasizing the importance of considering SDOH variability when evaluating operative day associations. The continued association between Monday operations and increased 90-day ER visits and hospital readmissions, along with the persistent correlation between Friday operations and decreased 90-day ER visits, even after adjusting for confounding elements suggest that factors such as discharge timing, outpatient care access, and postoperative care coordination may play a role in patient recovery timelines. Overall, in our patient population, pre-weekend lumbar fusion surgery does not appear to negatively impact patient outcomes, but further study is necessary to better characterize the relationship between operative scheduling, surgeon-specific factors, social risk factors, and postoperative care access following lumbar fusion surgery.

Declarations

Author Contribution

MM- data curation, validation, writing-original draft, review and editing; JK- data curation, writing-review and editing; JC- data curation, writing-review and editing; JA- data curation, writing-review and editing; RG- data curation, writing-review and editing; SM- data curation, writing-review and editing; AG- writing-review and editing; XY- writing-review and editing; PS- writing-review and editing; EO- writing-review and editing; SB- writing-review and editing; MF- conceptualization, data curation, formal analysis, supervision, writing- review and editing; DB- conceptualization, data curation, formal analysis, supervision, writing-review and editing

Data Availability

The datasets generated and analyzed during the study are not publicly available due to patient privacy and institutional data protection policies. De-identified data may be made available from the corresponding author upon reasonable request and with appropriate institutional approvals.

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