Original Article

Does physical therapy impact clinical outcomes after lumbar decompression surgery?

ABSTRACT

Objectives: The objectives of our study were to (1) determine if physical therapy (PT) impacts patient-reported outcomes (PROMs) after lumbar decompression surgery and (2) determine if PT impacts postsurgical readmissions or reoperations after lumbar decompression surgery.

Methods: Patients >18 years of age who underwent primary one- or two-level lumbar decompression at our institution were identified. Patient demographics, surgical characteristics, surgical outcomes (all-cause 90 days readmissions and 90 days surgical readmissions), and patient-reported outcomes (PROMs) were compared between the groups. Multivariate linear regression was utilized to determine the individual predictors of 90 days readmissions and PROMs at the 1-year postoperative point. Alpha was set at $P < 0.05$.

Results: Of the 1003 patients included, 421 attended PT postoperatively. On univariate analysis, PT attendance did not significantly impact 90-day surgical reoperations ($P = 0.225$). Although bivariate analysis suggests that attendance of PT is associated with worse improvement in physical function ($P = 0.041$), increased preoperative Visual Analogue Scale leg pain (0 = 0.004), and disability ($P = 0.006$), as measured by the Oswestry Disability Index, our multivariate analysis, which accounts for confounding variables found there was no difference in PROM improvement and PT was not an independent predictor of 90-day all-cause readmissions ($P = 0.06$). Instead, Charlson Comorbidity Index ($P = 0.025$) and discharge to a skilled nursing facility ($P = 0.013$) independently predicted greater 90-day all-cause readmissions.

Conclusions: Postoperative lumbar decompression PT attendance does not significantly affect clinical improvement, as measured by PROMs or surgical outcomes including all-cause 90 days readmissions and 90-day surgical readmissions.

Keywords: Lumbar vertebrae, physical therapy, postoperative period

INTRODUCTION

Improved management of chronic medical conditions has increased the prevalence of age-related spinal conditions, such as spinal stenosis, in the United States.[1] Lumbar decompression surgery is commonly used to treat lumbar spinal stenosis and provides good short-term clinical improvements, although these tend to diminish at the long-term follow-up.[2-7] As the United States population continues to grow older, physicians are increasingly apt to prescribe physical therapy (PT) after decompression to aid postoperative recovery for this growing demographic, despite a paucity of evidence suggesting that PT improves clinical outcomes.[8-10]

Few studies have investigated the utility of PT after lumbar decompression, and those that have, report conflicting

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evidence and draw limited conclusions.[9,10] The decision to prescribe PT after lumbar decompression surgery is often left to provider discretion due to the lack of standardized guidelines. In some instances, early PT is avoided as providers may fear increased rates of reinjury, including disc reherniation.[11] However, there is some evidence that early, aggressive PT may augment patient recovery.[12,13] Although PT is hypothesized to lead to significant improvements, a PT referral adds significant costs to a patient's care.[10] Due to the increasingly high volume of lumbar decompression surgeries, there is a critical need for guidance on appropriate recommendations for postoperative physical therapy.[6,14]

Therefore, the objectives of our study were to (1) determine if PT impacts patient-reported outcomes after spinal decompression surgery and (2) determine if PT impacts postsurgical readmissions or reoperations after lumbar decompression surgery.

METHODS

Inclusion criteria

Upon obtaining Institutional Review Board approval, all patients older than or equal to 18 years who underwent primary one- or two-level lumbar decompression at our academic medical institution between 2014 and 2021 were retrospectively identified. The following Current Procedural Terminology (CPT) codes were utilized for an inclusive list of patients undergoing decompression surgery at our institution: 63005, 63012, 63017, 63042, +63044, 63047, +63048, 63056, +63057, 63030, +63035, 62380. Patients were excluded if PT status was not documented in the electronic medical record and if the lumbar decompression was indicated in the setting of trauma, infection, or neoplastic disease.

Data extraction

Patient demographics, surgical characteristics, and surgical outcomes were collected through Structured Query Language search and manual chart review of the electronic medical records. Patients were categorized based on whether they attended PT following surgery. Demographic data collected included age, sex, body mass index (BMI), diabetic history, smoking status (nonsmoker, current smoker, and former smoker), and Charlson Comorbidity Index (CCI). The surgical characteristics included procedure type (discectomy/laminectomy and microdiscectomy), indication for surgery (radiculopathy, spondylolisthesis, spinal stenosis, intervertebral disc herniation, scoliosis, or cauda equina), revision procedures, levels decompressed, estimated blood loss, operative duration, length of stay, intraoperative durotomy, and discharge disposition (home, skilled nursing facility [SNF], and inpatient rehabilitation facility [IRF]). Surgical outcomes included all-cause 90 days readmission and 90 days surgical readmission (incision and drainage [I and D] procedures for presumed infection or hematoma/serom and dural repairs for cerebrospinal fluid [CSF] leak). Patient-reported outcome measures (PROMs) were retrospectively collected through our Institution's prospectively collected database (OBERD, Columbia, MO, USA) and were included at the preoperative and 1-year postoperative time points. PROMs extracted included the Visual Analog Scale for back pain (VAS back) and leg pain (VAS leg), the Oswestry Disability Index (ODI), and the Mental and Physical Component Scores of the Short-Form 12 (SF-12) Health Survey (MCS-12 and PCS-12, respectively).

Statistical analysis

Descriptive statistics, including mean and standard deviation, were used to report patient demographics, surgical characteristics, and surgical outcomes. A Shapiro–Wilk test was used to analyze the normality of each continuous variable. Parametric data were analyzed with independent *t*-tests, whereas nonparametric data were analyzed with Mann–Whitney U-tests. The categorical variables were analyzed with Pearson's Chi-square tests. Multivariate linear regression was used to determine the independent association of patient age, sex, BMI, CCI, smoking status, PT disposition, and the number of levels decompressed on ΔPROM scores at the 1-year postoperative point. R software, version 3.6.3 (R Foundation for Statistical Computing, Vienna, Austria), was used for all the data analysis. Statistical significance was set at a $P < 0.05$.

RESULTS

Patient demographics

Of 1003 patients included in the analysis, 421 patients (42.0%) attended PT and 582 (58.0%) did not. Patients who attended PT were older than those who did not (59.4 ± 16.2 years vs. 53.1 ± 15.4 years, $P < 0.001$). The remaining demographic variables, including sex ($P = 0.558$), BMI ($P = 0.959$), CCI ($P = 0.101$), a history of diabetes ($P = 0.126$), and smoking status ($P = 0.356$) were not significantly different between the two groups [Table 1].

Surgical characteristics

Patients who attended PT were significantly more likely to have had a microdiscectomy (15.9% vs. 8.25%, $P < 0.001$). They also had significantly longer hospital length of stays (1.09 ± 1.75 days vs. 0.64 ± 1.23 days, $P < 0.001$) and were significantly more likely to be discharged to a SNF or IRF ($P < 0.001$). There were no significant differences in the number of levels decompressed ($P = 0.094$), number of revision

Table 1: Demographics and surgical characteristics

	Did not attend PT (*n*=582)	Attended PT (*n*=421)	*P*[a]
Age (years)	53.1 (15.4)	59.4 (16.2)	<0.001*
Sex, *n* (%)			
Female	240 (41.2)	165 (39.2)	0.558
Male	342 (58.8)	256 (60.8)	
BMI (kg/m^2)	29.5 (5.88)	29.5 (5.90)	0.959
CCI	0.54 (1.00)	0.65 (1.04)	0.101
Diabetic, *n* (%)			
No	514 (88.3)	357 (84.8)	0.126
Yes	68 (11.7)	64 (15.2)	
Smoking status, *n* (%)			
Nonsmoker	324 (55.7)	244 (58.0)	0.356
Current smoker	125 (21.5)	75 (17.8)	
Former smoker	133 (22.9)	102 (24.2)	
Procedure, *n* (%)			
Discectomy/laminectomy	534 (91.8)	354 (84.1)	<0.001*
Microdiscectomy	48 (8.25)	67 (15.9)	
Revision procedures, *n* (%)			
No	520 (89.3)	379 (90.0)	0.809
Yes	62 (10.7)	42 (9.98)	
Levels decompressed, *n* (%)			
1	417 (71.6)	280 (66.5)	0.094
2	165 (28.4)	141 (33.5)	
Average levels decompressed	1.28 (0.45)	1.33 (0.47)	0.083
EBL (mL)	59.3 (56.6)	78.9 (86.9)	0.017*
Operative duration (min)	87.2 (29.8)	92.6 (39.9)	0.218
Length of stay (days)	0.64 (1.23)	1.09 (1.75)	<0.001*
Intraoperative durotomy, *n* (%)			
No	531 (91.2)	389 (92.4)	0.587
Yes	51 (8.76)	32 (7.60)	
Disposition status, *n* (%)			
Home	582 (100)	376 (89.3)	<0.001*
SNF	0	23 (5.46)	
IRF	0	22 (5.23)	

*Statistical significance ($P<0.05$); [a]Independent *t*-test, Mann–Whitney *U*-test or Pearson's Chi-square test. PT - Physical therapy; BMI - Body-mass index; CCI - Charlson Comorbidity Index; EBL - Estimated blood loss; SNF - Skilled nursing facility; IRF - Inpatient rehabilitation facility

procedures performed (9.98% vs. 10.7%, $P = 0.809$), operative duration ($P = 0.218$), or the presence of intraoperative durotomy between groups ($P = 0.587$) [Table 1].

In comparison to patients who did not attend PT, those who did attend had a significantly greater all-cause 90 days readmission rates (8.79% vs. 4.47%, $P = 0.008$), but there was no significant difference in the 90-day surgical readmission rate (3.26% vs. 4.99%, $P = 0.225$) between groups. Of the patients who attended PT, five patients had a surgical I and D, five had a draining seroma/hematoma evacuated, three had a CSF leak, three had a reoperation for adjacent segment disease, three had a revision decompression for recurrent index level pathology. The remaining two patients had two readmissions including one for a dural repair and another for a revision index level decompression, while the other patient underwent reoperation for a presumed draining hematoma/seroma and then subsequently had a reoperation for a dural repair. None of the causes of reoperation was significantly different between the groups that attended PT versus the group that did not (all, $P > 0.05$) [Table 2].

PROMs

Between those who attended PT and those who did not, the preoperative, 1 year postoperative, and ΔMCS-12 ($P = 0.833$; $P = 0.261$; $P = 0.189$, respectively) and ΔVAS back scores ($P = 0.864$; $P = 0.757$; $P = 0.498$, respectively) did not significantly differ. Although the 1-year postoperative ODI score ($P = 0.839$) and ΔODI ($P = 0.114$) was not significantly different between groups, the preoperative ODI score was significantly better (39.9 ± 17.3 vs. 46.9 ± 19.1, $P = 0.006$) in those who attended PT. The ΔPCS-12 was significantly lower (6.32 ± 11.4 vs. 9.69 ± 12.1, $P = 0.041$) in patients who attended PT while the preoperative ($P = 0.319$) and 1-year postoperative ($P = 0.072$) PCS-12 scores were not significantly different [Table 3].

Multivariate analysis

Multivariate linear regression analysis found that attending PT was not a predictor of ΔMCS-12 ($P = 0.454$), ΔPCS-12 ($P = 0.064$), ΔODI ($P = 0.191$), ΔVAS Leg ($P = 0.238$), or ΔVAS back ($P = 0.953$). However, CCI (odds ratio [OR] = −2.15; 95% confidence interval [CI] [− 4.16–−0.14], $P = 0.037$) was identified as a negative predictor of ΔMCS-12 improvement at 1 year. Age, sex, BMI, smoking status, and number of levels decompressed did not significantly impact any ΔPROMs [Table 4].

Multivariate logistic regression analysis determined CCI (OR = 1.26; 95% CI [1.01–1.54], $P = 0.025$) and SNF disposition (OR = 3.91; 95% CI [1.26–11.04], $P = 0.013$) to be significant positive predictors of all-cause 90 days readmissions while attending PT was not ($P = 0.061$). Age, sex, BMI, smoking status, and the number of levels decompressed did not predict 90-day all-cause readmission rates [Table 5].

DISCUSSION

PT is commonly prescribed after lumbar decompression surgeries, but evidence regarding its benefit is mixed.[9,10] At our institution, PT is prescribed based on provider preference and it is more commonly given to elderly patients who may be less likely to mobilize without assistance. This generality was confirmed in our study which found that older patients were more likely to attend PT, but interestingly, patients with worse baseline disability, as

Table 2: 90 days readmissions

	Did not attend PT (*n*=582), *n* (%)	Attended PT (*n*=421), *n* (%)	*P*[a]
All-cause 90 day readmissions			
No	556 (95.5)	384 (91.2)	0.008*
Yes	26 (4.47)	37 (8.79)	
90-day surgical readmission			
No	563 (96.7)	400 (95.0)	0.225
Yes	19 (3.26)	21 (4.99)	
Cause for 90-day surgical readmission			
I and D for surgical site infection			
No	577 (99.1)	416 (98.8)	0.750
Yes	5 (0.86)	5 (1.19)	
I and D for hematoma/seroma			
No	578 (99.3)	415 (98.6)	0.336
Yes	4 (0.69)	6 (1.43)	
Reoperation for CSF leak			
No	577 (99.1)	416 (98.8)	0.750
Yes	5 (0.86)	5 (1.19)	
Reoperation for same level pathology			
No	576 (99.0)	417 (99.0)	1.000
Yes	6 (1.03)	4 (0.95)	
Reoperation for adjacent segment disease			
No	582 (100)	418 (99.3)	0.074
Yes	0	3 (0.71)	

*Statistical significance ($P<0.05$); [a]Pearson's Chi-square test. PT - Physical therapy; I and D - Irrigation and debridement; CSF - Cerebrospinal fluid

Table 3: Patient-reported outcomes

	Did not attend PT	Attended PT	*P*[a]
MCS-12	*n*=107	*n*=99	
Preoperative	48.3 (11.7)	47.9 (11.9)	0.833
1-year postoperative	51.3 (11.5)	53.2 (10.7)	0.261
Delta	2.39 (10.9)	4.49 (14.6)	0.189
PCS-12	*n*=107	*n*=100	
Preoperative	30.7 (8.13)	31.6 (8.69)	0.319
1-year postoperative	40.1 (10.9)	37.6 (10.6)	0.072
Delta	9.69 (12.1)	6.32 (11.4)	0.041*
ODI	*n*=93	*n*=76	
Preoperative	46.9 (19.1)	39.9 (17.3)	0.006*
1-year postoperative	24.8 (24.0)	22.9 (18.2)	0.839
Delta	−23.61 (25.1)	−18.07 (20.3)	0.114
VAS back	*n*=101	*n*=82	
Preoperative	5.45 (3.08)	5.64 (2.71)	0.864
1-year postoperative	3.26 (2.90)	3.36 (2.71)	0.757
Delta	−2.30 (3.38)	−2.44 (3.22)	0.498
VAS leg	*n*=101	*n*=82	
Preoperative	7.03 (2.34)	6.15 (2.50)	0.004*
1-year postoperative	3.04 (2.93)	3.00 (2.83)	0.918
Delta	−4.16 (3.36)	−3.39 (3.51)	0.208

*Statistical significance ($P<0.05$); [a]Independent *t*-test or Mann–Whitney *U*-test. PT: physical therapy; MCS - Mental component score of the short-form 12; PCS - Physical component score of the short-form 12; ODI: Oswestry Disability Index; VAS: Visual Analog Scale

measured by ODI, were less likely to attend PT. On regression analysis, a patients baseline demographics, not PT attendance, appear to be the best predictors of improvement in disability, physical function, or pain, although this only reached significance for CCI, which predicted worse improvement in MCS-12. Our study also suggests that on multivariate analysis, attending PT is unrelated to all-cause 90 days readmission and 90 days surgical readmissions, indicating that it is a safe postoperative modality for patients who believe it may provide them some benefit.

Literature evaluating the effectiveness of PT attendance following lumbar decompression indicates there is likely no significant relationship between PT and clinical outcomes improvement. A recent randomized controlled trial of 146 patients found no difference in PROMs (VAS-leg, VAS-back, and ODI) between patients who attended PT versus those who did not following lumbar discectomy.[15] These findings are in accordance with a separate randomized controlled trial of 169 patients who underwent lumbar discectomy followed by PT, which also suggests PT does not improve PROMs (mental and physical components of the SF-12, global perceived effect, VAS for pain intensity back and leg, and ODI) nor is it cost-effective.[8] Our analysis supports both trials, while also providing a larger sample size. Although our bivariate analysis does suggest that patients who attended PT experience less improvement in 1-year physical function, our multivariate analysis found this is likely due to confounding since PT attendance did not remain independently predictive of PROM improvement after controlling for age, sex, BMI, CCI, and smoking status. It should be noted, a nonsignificantly lower magnitude of improvement in PCS-12 is seen in patients who attend PT, which is likely due to the nonrandomization of patients in our cohort resulting in selection bias.

A systematic review conducted in 2014 evaluated the effect and homogeneity of PT programs after lumbar decompression surgeries.[10] In this study, 22 manuscripts and 2500 patients were included.[10] Analysis was stratified by timing of PT initiation and concluded that low to very low-quality evidence exists to support PT starting between 4 and 6 weeks after lumbar decompression surgery.[10] In 2016, a meta-analysis of four studies totaling 250 participants was performed.[16] They found moderate evidence that PT for 4 weeks postoperatively can be effective for pain reduction after lumbar decompression with no increased risk for adverse events.[16] However, the clinical impact of PT referrals following lumbar decompression has been demonstrated to not provide any appreciable cost-effectiveness.[10] Given the conflicting evidence on this topic, additional high-quality studies are warranted.

Table 4: Multiple linear regression of Delta patient-reported outcomes at 1 year

Predictors	Delta PCS-12			Delta MCS-12			Delta ODI			Delta VAS leg			Delta VAS back		
	Estimate	95% CI	*P*	Estimate	95% CI	*P*	Estimate	95% CI	*P*	Estimate	95% CI	*P*	Estimate	95% CI	*P*
Age	−0.03	−0.15–0.09	0.609	0.05	−0.08–0.19	0.421	0.13	−0.14–0.40	0.343	0.02	−0.02–0.06	0.280	−0.02	−0.06–0.02	0.355
Male sex	−0.45	−3.77–2.88	0.793	0.72	−2.91–4.36	0.698	−5.95	−13.21–1.31	0.110	−0.71	−1.75–0.33	0.180	−0.44	−1.45–0.57	0.397
BMI	0.08	−0.22–0.39	0.586	0.10	−0.23–0.43	0.546	0.08	−0.55–0.72	0.797	−0.01	−0.10–0.08	0.842	−0.01	−0.10–0.08	0.793
CCI	−1.20	−3.04–0.65	0.205	−2.15	−4.16–−0.14	0.037*	3.71	−0.34–7.79	0.076	0.12	−0.45–0.68	0.685	0.26	−0.29–0.81	0.355
Smoking status															
Nonsmoker	Reference			Reference			Reference			Reference			Reference		
Current smoker	−4.64	−9.83–0.54	0.081	−2.91	−8.55–2.72	0.312	5.49	−7.63–18.61	0.413	0.29	−1.43–2.01	0.742	1.04	−0.63–2.72	0.222
Former smoker	−1.63	−5.58–2.32	0.419	−2.47	−6.78–1.85	0.264	2.51	−5.90–10.91	0.560	0.90	−0.32–2.13	0.149	0.62	−0.57–1.80	0.311
PT disposition															
No PT	Reference			Reference			Reference			Reference			Reference		
Yes PT	−3.22	−6.61–0.17	0.064	1.41	−2.28–5.11	0.454	4.91	−2.41–12.23	0.191	0.63	−0.41–1.67	0.238	0.03	−0.98–1.04	0.953
Levels decompressed															
1-level	Reference			Reference			Reference			Reference			Reference		
2-level	1.39	−2.09–4.88	0.433	1.00	−2.80–4.80	0.605	1.13	−6.52–8.77	0.773	0.36	−0.73–1.46	0.515	−0.43	−1.49–0.63	0.428

*Statistical significance ($P<0.05$). MCS - Mental component score of the short-form 12; PCS - Physical component score of the short-form 12; ODI - Oswestry disability index; VAS - Visual Analog Scale; CI - Confidence interval; BMI - Body-mass index; CCI - Charlson Comorbidity Index; PT - Physical therapy

Table 5: Multiple logistic regression of 90 days all cause readmissions

Predictors	All-cause 90 days readmissions			
	Estimate	OR	95% CI	*P*
Age	−0.0012	1.00	1.00–1.02	0.900
Male sex	−0.42	0.65	0.38–1.11	0.115
BMI	−0.038	0.96	0.92–1.01	0.122
CCI	0.23	1.26	1.01–1.54	0.025*
Smoking status				
Nonsmoker	Reference			
Current smoker	0.64	1.89	0.96–3.64	0.058
Former smoker	0.47	1.59	0.83–3.02	0.157
PT disposition				
No PT	Reference			
Yes PT	0.54	1.73	0.97–3.07	0.061
Disposition status				
Home	Reference			
SNF	1.36	3.91	1.26–11.04	0.013*
IRF	0.90	2.47	0.63–7.94	0.152
Levels decompressed				
1-level	Reference			
2-level	0.10	1.10	0.61–1.96	0.740

*Statistical significance ($P<0.05$). CI - Confidence interval; BMI - Body-mass index; CCI - Charlson Comorbidity Index; PT - Physical therapy; SNF - Skilled nursing facility; IRF - Inpatient rehabilitation facility; OR - Odds ratio

There is sparse evidence on whether PT impacts adverse events, including readmission or reoperation rates following lumbar spinal decompression. The aforementioned randomized controlled trial of 146 patients suggested that there is no appreciable difference in revision rates between patients who attend PT versus those who did not over.[15] In a secondary analysis of the same study, no difference in sick leave duration, return to work, or working ability was found in patients between the two groups.[17] Similarly, a Cochrane review found no studies where PT or exercise regimens resulted in increased reoperation rates.[10] Our bivariate analysis suggests that in the first 90 days, surgical readmissions were the same between groups, providing additional validity to the prior studies. Although our bivariate analysis indicated that attending PT is associated with increased all-cause 90 days readmissions, our multivariate analysis suggests this was likely due to the greater CCI and SNF disposition rates among patients attending PT instead of PT attendance. In fact, both SNF disposition and a greater CCI have previously been reported to be independent predictors of increased readmission rates following surgery.[18,19]

In an era of cost-effective care, surgeons should consider whether each individual patient is likely to substantially benefit from postoperative physical therapy. At this time, evidence remains inconclusive, although most studies

have found PT does not provide patients with any meaningful benefit when done in conjunction with a lumbar decompression, with current evidence including randomized controlled trials.[8,15] Until more robust evidence emerges, surgeon discretion should continue to dictate whether a patient is prescribed formal physical therapy, although patients should be informed no strong evidence supports PT attendance.

This study is not without limitations, including those inherent to any retrospective analysis. While PT attendance was determined through query and manual chart review, we were unable to analyze the duration of PT attendance or timing of PT initiation due to the lack of granularity in our electronic medical records and because the majority of patients attend PT outside of our hospital system. We also could not determine the patient-specific PT protocol each patient followed. It should be noted that even with this data, there is significant variation between the characteristics of individual PT programs in existing literature, which makes drawing accurate conclusions on any potential benefit from PT challenging.[10] However, we acknowledge that continued research on the specifics of PT interventions is warranted and likely needed to make confident recommendations. Because this was not a controlled study, provider bias may have affected the prescription of PT referrals leading to demographic and patient-reported outcome differences within the cohorts. However, we attempted to control for these confounding variables through the multivariate analysis.

CONCLUSIONS

Postoperative PT attendance does not significantly affect patient-reported outcomes measure improvements at the 1-year postoperative point following lumbar decompression. Similarly, PT attendance does not significantly impact rates of 90 days surgical readmissions or all-cause 90 days readmissions following lumbar decompression surgery. Within our study, PT referrals were largely dependent on provider discretion, leading to differences within the PT groups, which highlights the need for additional high-quality prospective studies to improve our understanding of the impact of postoperative PT on surgical and clinical outcomes in patients undergoing lumbar decompression surgery.

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Conflicts of interest

There are no conflicts of interest.

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