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Clinical Study

Effect of spinal decompression on back pain in lumbar spinal stenosis: a Canadian Spine Outcomes Research Network (CSORN) study

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ABSTRACT

BACKGROUND CONTEXT: Surgical decompression is usually offered for improvement of neurogenic claudication in patients with symptomatic lumbar canal stenosis. These patients often have associated low back pain (LBP) and little is known about the effect of decompression on this symptom.

PURPOSE: The goal of the present study is to specifically quantify the improvement in LBP following surgical decompression for lumbar canal stenosis and to identify factors associated with changes in LBP in this population.

STUDY DESIGN: This is a multicenter, retrospective review of consecutive spine surgery patients enrolled by the Canadian Spine Outcomes and Research Network.

PATIENT SAMPLE: Consecutive patients who underwent surgical treatment for symptomatic lumbar spine stenosis without instability between 2014 and 2017.

OUTCOME MEASURES: Change in LBP on the Numeric Rating Scale (NRS).

METHODS: Patient-reported outcomes were collected at baseline and at 3, 12, and 24 months after surgery. The primary outcome was change in LBP on the NRS. Multivariable logistic regression was

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used to model the relationship between the outcome and potential factors associated with achieving minimal clinical important difference in back pain using a backward selection procedure.

RESULTS: In all, 1,221 patients were included in the analysis. Mean age was 64 years and 58% were males. Baseline back pain scores were available in 1,133 patients and follow-up evaluations were available in 968/1,133 (85%) patients at 3 months, 649/903 (72%) patients at 12 months, and 331/454 (73%) at 24 months. LBP significantly improved 3 months after surgery and the improvement was sustained at 24 months ($p<.001$). We found that 74% of patients reached the minimal clinical important difference in back pain. Predictive factors for sustained improvement (12 and 24 months) in LBP after surgical intervention were absence of narcotic usage or compensation claims and increased severity of LBP before surgery (high NRS).

CONCLUSIONS: Alleviation of clinically significant LBP was observed at 3 months after lumbar decompression surgery for neurogenic claudication and was maintained at 12 and 24 months after surgery in the majority of patients.

Keywords: Decompression; Low back pain; Lumbar spine; Neurogenic claudication; NRS; Spinal stenosis

Introduction

Lumbar spine stenosis is prevalent in the aging population [1] and, although the natural history is often benign [2,3], associated neurogenic claudication can cause significant discomfort and limitations to daily activities and result in severe disability [1,4]. Presently, symptomatic stenosis is the most common indication for lumbar spine surgery in older adults [5,6]. While patients commonly present with symptoms of neurogenic claudication, low back pain (LBP) is a commonly associated symptom contributing to disability [7–11]. There is high quality evidence that surgical intervention results in good relief of leg symptoms with improvement in functional and disability status [12–14] but uncertainty remains around the impact of surgical treatment on LBP [4,6,13–16]. Improvement in back pain has not been so far investigated. In fact, it is usually accepted that despite adequate surgical treatment, residual back pain often remains and that back pain without neurogenic claudication does not represent a surgical indication [5,7,17,18]. The purpose of this study was to look specifically at the effect of surgical intervention on back pain in patients with lumbar spine stenosis causing neurogenic claudication. The goal was to quantify the improvement in LBP after surgical decompression and further investigate factors within this population that could have an effect on LBP symptoms.

Materials and methods

We conducted a multicenter, retrospective review of consecutive spine surgery patients prospectively enrolled by the Canadian Spine Outcomes and Research Network (CSORN) between 2014 and 2017.

Canadian Spine Outcomes and Research Network is a group of over 50 neurosurgical and orthopedic spine surgeons from 18 tertiary care academic and nonacademic hospitals across Canada that prospectively collects data on patients with spinal conditions. This database serves as a national registry created to answer research questions and to facilitate the implementation of best practices.

A national database research coordinator audits data quality and performance, and sends reports to each contributing hospital site coordinator on a quarterly basis. Reports track data completion and follow-up rates to facilitate internal data validation at each site. A national privacy and security framework was created for CSORN that includes a governance structure, standard operating procedures, training processes, physical and technical security, and privacy impact assessments. This model ensures privacy and security of personal health information. Written informed consent is obtained from all participating patients. Patient identification is anonymized to ensure that patients in the network cannot be individually identified. All participating sites obtained Research Ethics Board approval before any data collection. Decisions regarding data collection, storage, and analysis are independent of any company or commercial interest.

Patient variables

Collected baseline preoperative patient characteristics included socio-demographic factors (age, sex, body mass index, nicotine use, education level, work status, marital status, and others), medication and resource utilization, comorbidities, and symptoms.

Study measures

The surgeons recorded operative and postoperative variables including type of procedure, operating time, blood loss, and adverse events. The research coordinator tabulated the length of hospital stay. Research coordinators, unaware of the study hypothesis, collected patient-reported outcome measures (PROMs) at baseline, 3 months, 12 months, and 24 months postoperatively, either in person, via post, or by employing an online patient portal. Baseline PROMs were repeated for those waiting longer than 6 weeks before surgery. PROMs used were the Oswestry Disability Index (ODI) [19], the Numerical Rating Scale (NRS) for back and leg pain [20], the EuroQol EQ5D [21], and the SF-12 Physical (PCS) and Mental Component Summary [22]. Our

primary outcome was reaching the minimal clinically important difference (MCID) in back pain measured with the NRS on a 10-point scale We considered the MCID as a change of two points, as previously described [23].

Study interventions

We included consecutive patients who underwent surgical treatment for lumbar spinal stenosis without instability (1–2 level) at every participating site. All patients had a preoperative standing radiograph and patients with scoliosis and/or degenerative spondylolisthesis were excluded. The type of surgical intervention was decided by the treating surgeon and included decompression with or without fusion via an open or minimally invasive approach.

Statistical analysis

The independent variables used in this study were measured on either categorical or continuous scales. The dependent variable (NRS pain scale) was categorized into minimal clinically important change (yes = 1, no = 0); Thus, multivariable logistic regression was used to model the relationship between the outcomes and explanatory variables of interest using a backward conditional selection procedure.

Results

In all, 1,221 patients were included in the final analysis. Mean age was 63.9 years and 58% were males (Table 1). Since not every patient have reached their 2-year follow-up, we report on eligible patients at each follow-up time points, that is, the proportion of patients with available data among those who reached each follow-up time point. Baseline back pain scores were available in 1,133 patients and follow-up evaluations were available in 968/1,133 (85%) patients at 3 months, 649/903 (72%) patients at 12 months, and 331/454 (73%) at 24 months. Surgical intervention was predominantly decompression alone (72%) but fusion was added in 26% of patients (Table 2). The open approach was employed more often than a minimally invasive approach. The primary outcome measure was a change in LBP measured by the NRS and is detailed in Table 3. We found that LBP significantly improved 3 months after surgery and was sustained to 24 months ($p<.001$) in the proportion of patients who have reached 2-year follow-up.

An improvement in back pain equal or greater than MCID (as measured with NRS) was achieved in 74% of patients at 3 months postoperatively and 68% remained clinically significantly improved at 2 years following surgery. The proportion of patients who had no or minimal residual back pain (NRS 0–2) also increased significantly from 7.5% at baseline to 46.4 % at 12 months and 40.9% at 24 months (Table 3.1).

Comparison of leg pain improvement with back pain symptoms showed that a higher number of patients reached the MCID for leg pain than for back pain initially (76% vs. 74%) and a similar trend maintained at 24 months (70% vs. 68%). We found that at 3 months, 82.3% of patients who had improvement of their leg symptoms also had back pain improvement reaching MCID, and this proportion was 77% at 24 months (Table 4).

The addition of a fusion did not impact the improvement in back pain. At 3 and 24 months, the magnitude of improvement was similar between the fusion and no fusion group. At 12 months, improvement in back pain was greater in patients who had a decompression alone (Table 5.1). When looking at our primary outcome, the fusion group had a higher percentage of patients who reached the MCID for back pain at 3 months, but this was not maintained at 12 and 24 months (Table 5).

Factors associated with change in back pain

Patient factors predictive of achieving the MCID in LBP at 3, 12, and 24 months postoperatively were absence of narcotic usage, absence of any compensation claims and increasing LBP severity before surgery (high NRS; Tables 6–6.2). Other factors such as level of education and higher health state score showed a weak association with

Table 1
Patient baseline characteristics

Age	Mean (SD) Range	63.9 (11.6) y 25–90 y
Gender	Male	711 (58.2%)
	Female	510 (41.8%)
Smoker	Yes	211(17.3%)
	No	921 (75.4%)
BMI	Mean (SD) Range	29 (5.5) 15–60
EQ-5D	Mean (SD) Range	0.54 (0.2) −0.11 to 1.00
Working status	Employed	275 (58.4%)
	Not employed	196 (41.6%)
Duration of back pain	0–3 mo	27
	3–12 mo	150
	1–2 y	138
	>2 y	325
	Not known	10

Table 2
Details of surgical intervention

Surgical procedure	Discectomy/decompression	617
	Fusion with discectomy/ decompression	227
	Not known	8
Surgical approach	MIS	357
	Open	495
Surgical time	Mean (SD)	117.64 min (67.12)
	Range	30-800 min
Adverse event occurrence	Intraop	70 (8.2%)
	Periop	109 (13.2%)
	Postop	55 (10.6%)
Length of stay	Mean (SD)	3.9 d (22.44)
	Range	0–371 d

Table 3
Change in back pain scores – NRS

	Baseline	3 Mo	12 Mo	24 Mo
N	1133	977	677	342
NRS Mean (SD)	6.83 (2.38)	−3.29 (2.47)	−3.42 (2.71)	−3.58 (2.82)
% Reaching MCID (NRS)		73.9	68	68.3
p		<.001	<.001	<.001

Table 3.1
Patients with no or minimal back pain (NRS 0–2)

	N	NRS 0–2	%
At baseline	1,133	85	7.5
3 mo	977	435	44.5
12 mo	677	314	46.4
24 mo	342	140	40.9

Table 4
Percentage of patients reaching MCID leg pain who also had back pain improvement

	N	VAS leg pain Mean (SD)	% MCID leg pain	% MCID back pain
3 mo	977	3.31 (2.9)	711	585
12 mo	677	3.52 (3.1)	479	380
24 mo	344	3.65 (3.0)	234	182

Table 5
Comparison of MCID with and without fusion

3 Mo	Fusion	No fusion	Pearson chi square
Total patients	326	600	
% with MCID	253 (77.6%)	431 (71.8%)	0.05
12 mo			
Total patients	265	386	
% with MCID	187(70.6%)	256 (66.3%)	0.25
24 mo			
Total patients	191	143	
% with MCID	134(70.2%)	94(65.7%)	0.39

improvement in LBP at 3 months but were not predictive at longer follow-up. The type of surgical intervention (ie, decompression alone vs. fusion and decompression, or MIS vs. open), the occurrence of intraoperative or postoperative adverse events, surgical time or length of stay did not predict a change in back pain scores (Tables 6–6.2).

Discussion

We report an improvement of back pain following surgical intervention for symptomatic lumbar spinal stenosis without instability that reached clinical and statistical significance in 74% of patients at 3 months, and was maintained in over two-thirds of patients at 12-month follow-up. Because we considered the change in NRS as opposed to the actual scores we obtained a more accurate estimate of the treatment effect irrespective of baseline [16]. The proportion of patients with minimal or no back pain passed from 7.5% at baseline to 46% at 1 year and 40% at 2 years after surgery. Absence of narcotic usage and compensation claims as well as severe baseline LBP were associated with a higher likelihood of having a clinically significant improvement in back pain. However, the type of surgical intervention did not impact this outcome.

The goal of surgery for lumbar stenosis is to treat the symptoms of neurogenic claudication with improvement in walking distance and leg pain. Improvement in back pain is considered unreliable [7,18] and patients are usually cautioned about their expectations around LBP improvement.

Table 5.1
Comparison of VAS change in back pain with or without fusion

					95% CI		
3 Mo	N	Mean	SD	SEM	Lower	Upper	*t* Test (2-tailed sig.)
Fusion	326	−3.75	2.724	0.151	−0.086	0.685	0.127
No fusion	600	−3.46	3.074	0.126			
					95% CI		
12 Mo	N	Mean	SD	SEM	Lower	Upper	*t* test (2-tailed sig.)
Fusion	386	−3.15	3.200	0.163	−0.0.68	1.035	0.026
No fusion	600	−3.46	3.074	0.126			
					95% CI		
24 Mo	N	Mean	SD	SEM	Lower	Upper	*t* test (2-tailed sig.)
Fusion	191	−3.38	2.999	0.217	−0.324	1.088	0.313
No fusion	143	−3.03	3.141	0.263			

Table 6
Multivariate analysis – associated factors. At 3 months – patient and surgical factors

							95% CI for EXP(B)	
Patient factors	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
University education	0.704	0.239	8.691	1	0.003	2.021	1.266	3.226
No claims	0.549	0.300	3.341	1	0.068	1.731	0.961	3.119
No narcotic usage	0.739	0.256	8.350	1	0.004	2.093	1.268	3.454
Health state score	0.012	0.007	2.679	1	0.102	1.012	0.998	1.026
ODI score	0.027	0.011	6.056	1	0.014	1.027	1.005	1.049
EQ5D	1.704	0.740	5.299	1	0.021	5.494	1.288	23.43
Surgical factors								
Stenosis surgery > 1 level	0.132	0.312	0.178	1	0.673	1.141	0.619	2.101
MIS approach	0.088	0.237	0.139	1	0.710	1.092	0.687	1.736
Surgical time	0.000	0.003	0.010	1	0.920	1.000	0.995	1.006
Fusion	−0.050	0.429	0.013	1	0.908	0.952	0.411	2.206
LOS	0.032	0.051	0.407	1	0.524	1.033	0.935	1.141
Adverse event - intraop	−0.199	0.461	0.187	1	0.665	0.819	0.332	2.022
Adverse event – periop	0.110	0.311	0.126	1	0.723	1.117	0.607	2.056
Adverse event – postop	0.129	0.363	0.126	1	0.723	1.138	0.558	2.319

Table 6.1
Multivariate analysis – associated factors. At 12 months - patient and surgical factors

							95% CI for EXP(B)	
Patient factors	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Living alone	0.740	0.382	3.748	1	0.053	2.096	0.991	4.435
No claims	0.708	0.341	4.306	1	0.038	2.030	1.040	3.964
Severity of LBP	0.476	0.065	53.842	1	0.000	1.610	1.418	1.828
PHQ 9	−0.052	0.024	4.621	1	0.032	0.950	0.906	0.995
ODI score	−0.015	0.011	2.097	1	0.148	0.985	0.965	1.005
Surgical factors								
>1 Level surgery	0.050	0.408	0.015	1	0.902	1.052	0.472	2.342
MIS approach	0.019	0.331	0.003	1	0.955	1.019	0.533	1.950
Surgical time	−0.001	0.003	0.062	1	0.804	0.999	0.993	1.005
Fusion	0.112	0.657	0.029	1	0.865	1.118	0.308	4.053
LOS	0.013	0.035	0.130	1	0.719	1.013	0.946	1.084
Adverse event – intraop	0.468	0.589	0.629	1	0.428	1.596	0.503	5.068
Adverse event – periop	−0.080	0.407	0.039	1	0.843	0.923	0.415	2.050
Adverse event: postop	0.292	0.462	0.399	1	0.528	1.339	0.542	3.309

In this study, more than three-quarters of patients who had significant leg pain relief also had back pain relief, confirming that surgical decompression yields better results for leg symptoms than for back pain, but revealing an associated improvement of back pain in a substantial number of cases. Currently available data about LBP improvement is from long-term observational and Randomised Controlled Trial (RCT) studies where the effect of surgical intervention on LBP was usually a secondary outcome measure [4,5,11,12,17]. In addition, standardized measures of LBP were either lacking or were inconsistently applied [6,13,24,25].

The presence of significant LBP usually is considered a predictor of poor outcome after surgery for LSS [26]. However, we found that increased severity of back pain at baseline seemed to be associated with a higher likelihood of reaching the MCID for LBP improvement at both early and late follow-up. It is possible that the benefit of surgical intervention for reducing back pain is highest for patients with worse baseline scores, although this may also reflect a ceiling effect conferred by low NRS scores or a regression toward the mean phenomenon. A similar treatment effect tendency was also reported in the SPORT trial with respect to ODI [15,27].

Another factor that showed association with MCID back pain improvement was the absence of narcotic usage. There has been recent concern about increased use of opioid analgesia in the treatment of chronic pain not related to cancer.

Table 6.2
Multivariate analysis – associated factors. At 24 months – patient and surgical factors

							95% CI for EXP(B)	
Patient factors	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
No claims	1.364	0.662	4.249	1	0.039	3.913	1.069	14.320
Severity of LBP	0.467	0.118	15.763	1	0.000	1.595	1.266	2.008
No narcotic usage	0.890	0.596	2.232	1	0.135	2.435	0.758	7.825
Constant	−3.734	0.990	14.219	1	0.000	0.024		
Surgical factors								
>1 Level surgery	1.059	0.836	1.603	1	0.206	2.883	0.560	14.852
MIS approach	0.750	0.806	0.867	1	0.352	2.117	0.436	10.273
Surgical time	0.008	0.008	0.976	1	0.323	1.008	0.992	1.023
Fusion	−0.429	1.206	0.126	1	0.722	0.651	0.061	6.923
LOS	−0.156	0.128	1.482	1	0.223	0.856	0.666	1.100
Adverse event periop	−1.241	0.909	1.864	1	0.172	0.289	0.049	1.717
Adverse event postop	0.238	1.052	0.051	1	0.821	1.268	0.161	9.970
Estimated blood loss	0.000	0.000	1.368	1	0.242	1.000	0.999	1.000
Single surgical level	0.348	0.468	0.555	1	0.456	1.417	0.567	3.543
Constant	−0.164	1.501	0.012	1	0.913	0.848		

Predominantly, these are used for back pain or arthritis [28,29]. Large population-based studies have found that users of opioid analgesia tend to have a poor health-related quality of life and show poor recovery from any therapeutic intervention. However, long-term longitudinal studies analyzing the effect of opioid usage and recovery from chronic pain are lacking [29,30]. In addition, patients with opioid dependence who are on workers compensation have generally poorer outcomes after surgery [31]. While there is limited evidence about the association of pain and compensation claims, there is moderate to strong evidence that compensation claims are associated with poor physical and psychological health [32]. With respect to lumbar disc herniations, a post hoc analysis of the SPORT trial demonstrated that patients without compensation had significantly greater improvement with surgical treatment [33]. Similarly, this study demonstrates that compensation-related factors should be considered confounders for poorer back pain improvement after surgical intervention for spinal stenosis.

Current literature suggests that decompression alone for spinal stenosis without instability provides good relief of leg pain [12,34,35]. The effect of the choice of a specific surgical intervention on the improvement in back pain has however not been investigated. Several different surgical procedures are performed for this condition [36] and the primary goal of the operation is intended to address the narrowed spinal canal. In our study, the decision to perform a fusion or not was left to the discretion of the treating surgeon and no specified protocol (to perform a fusion or not) was established. Despite the available literature on the matter [34,35], a proportion of our patients (26.4%) received a fusion. The rationale for supplementing neural decompression with arthrodesis was not captured in this cohort but we can hypothesize that the surgeon felt that the decompression required would compromise the stability enough to warrant a fusion. While a slightly higher proportion of patients with fusion reached the MCID at 3 months, this was not maintained at longer follow-up and we were unable to demonstrate a significant difference in the magnitude of back pain improvement between patients who had fusion compared with those who had a decompression alone. Moreover, in the multivariate analysis, no significant association between fusion and reaching the MCID for back pain in this study population was seen. Similarly, use of minimally invasive procedures did not have an impact on outcome related to back pain. Therefore, based on the results of this study, it would seem that the presence of back pain in patients with spinal stenosis without associated scoliosis or spondylolisthesis is not a reason to add a fusion to the decompression procedure.

Unrealistic patient expectation is a predictor of poor outcome after surgery for symptomatic lumbar stenosis [26]. These procedures are often performed in older patients with complex medical problems and increased risks of spine surgery [24,37–39]. It is important that we evaluate the outcomes of surgical intervention and can discuss the benefits and potential risks on an individual basis. Prospectively collected data from the CSORN allow us to report on care as actually provided without rigid inclusion and exclusion criteria. The results of this study are representative of real-life clinical practice and complement data from RCTs and other observational studies.

Long-term observation studies where back pain scores were considered a secondary outcome measure also showed there was some improvement with surgical intervention but not as significant as improvement in ODI [15]. Based on the findings of this study, we are able to quantify this

improvement further. We hypothesize that LBP associated with spinal stenosis has a possible correlation to the neurogenic claudication and the compression of the neural elements and thus benefit from adequately addressing the stenosis component. Ultimately, this helps surgeons to manage patient expectations and counsel them about potential effects of surgical intervention on their symptoms. Based on the findings of this study, surgeons can tell their patients that they have a 74% chance of achieving a clinically meaningful reduction in their back pain following surgical intervention for neurogenic claudication.

Some of the limitations of this study are inherent to registry-based research: data and quality are only as good as the data input [40]. Our 2-year follow-up results are only available in about 73% of patients initially enrolled but we anticipate this will improve as the registry matures and more patients would reach the 2-year follow-up criteria.

The lack of a standardized surgical approach may have negatively impacted our results but on the other hand it contributes to the generalizability of our conclusions. Another limitation is the absence of a control group to assess how back pain evolves over time with nonoperative management. Considering the proven superiority of surgical management for significantly limiting symptomatic lumbar spinal stenosis [35,41], it is difficult to discourage surgical treatment to our population.

Conclusions

Low back pain is significantly improved in 74% of patients immediately after surgery for symptomatic stable lumbar spinal stenosis and at 2 years over two-thirds of patients continue to have significant relief of LBP symptoms. We found that the absence of narcotic usage, no medico-legal/compensation claims, and higher baseline severity of LBP were associated with significant improvement in LBP symptoms but that there was no significant correlation with type of surgical procedure performed.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at https://doi.org/10.1016/j.spinee.2019.01.003.

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