The Canadian surgical wait list for lumbar degenerative spinal stenosis has a detrimental effect on patient outcomes

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Abstract

Background: Waits for elective spine surgery are common in the Canadian health care system. We examined whether a prolonged wait for lumbar degenerative spinal stenosis surgery (LDSS) was detrimental to outcome.

Methods: We screened consecutive patients for eligibility upon referral to our centre between February 2006 and June 2010. Outcome measures including the SF-36-physical and mental component summary scores, Oswestry Disability Index, Zurich Claudication Questionnaire, back and leg pain numeric rating scale, and satisfaction were completed at referral, preoperatively, and until 24 months postoperatively. Wait time was defined as referral to surgery, and was categorized as prolonged if longer than the median wait.

Results: Of 1126 referrals, 166 patients met inclusion criteria. Two year follow-up was achieved by 85% of patients. The median wait time was 349 days. At referral, participants with short waits (≤ 12 months) had poorer mental well-being ($p = 0.001$), more disability ($p = 0.040$), and worse leg pain ($p = 0.026$). All HRQoL measures deteriorated during the waiting period. However, the magnitude of the deterioration was not affected by wait time. At 12 months following surgery a short wait saw greater improvement in mental well-being ($p = 0.010$), disability ($p = 0.002$), and leg pain ($p = 0.019$). At 24 months there was no longer a statistical difference in outcome or satisfaction between those with short and long waits.

Interpretation: Participants awaiting surgery experienced deterioration in HRQoL irrespective of the length of waiting time. However, prolonged waits for LDSS had a greater detrimental effect.

Introduction

Lumbar Degenerative Spinal Stenosis (LDSS) has a profound negative effect on an individual's function and quality of life. The preoperative health-related quality of life (HRQoL) measures are worse compared to those for other conditions such as congestive heart failure, COPD, cancer, or other frequently performed orthopaedic procedures [1-3]. LDSS is the leading indication for lumbar spinal surgery in patients over 65 years of age [1, 4] which is recognized to be superior to non-operative care [4-8]. The improvement in quality of life following surgery compares favorably to that achieved following total hip or knee arthroplasty - recognized as the gold standard and bench mark in orthopaedic surgery for achieving improvement in pain, function, and quality of life [3, 9, 10].

Unfortunately, in Canada, the wait time for spinal procedures continues to increase with a perceived detrimental effect on outcome and satisfaction [11]. Furthermore, with the aging demographic of Canadian society these wait times may only worsen with time. The effect these prolonged wait times have on a patient's HRQoL and postoperative outcome are unknown for LDSS. Our primary objective was to determine whether longer waits to LDSS surgery were associated with poorer preoperative and postoperative HRQoL. Secondarily we aimed to determine the effect of wait time on patient's satisfaction with treatment.

Methods

Study setting and population

We conducted a prospective observational study on patients referred to three fellowship trained orthopaedic spine surgeons at the London Spine Centre, London Health Sciences Centre, for the treatment of LDSS. This study was approved by our institutional research ethics board. We screened consecutive referrals for eligibility between February 2006 and June 2010. Inclusion criteria included: neurogenic claudication or radiculopathy secondary to central or lateral recess stenosis between L1-S1

confirmed by CT or MRI, and patient consent for surgical treatment. Patients were excluded if the stenosis was not degenerative (i.e. traumatic stenosis from a pathologic fracture), they had inflammatory spine disease, severe or progressive neurologic deficit requiring urgent surgery, cancer, previous lumbar surgery, an inability to complete the questionnaires or provide follow-up (i.e. lack of permanent address, substance abuse, interfering psychiatric illness), or were pregnant.

Study Design

We screened referrals from the referring physician and to patients satisfying the inclusion criteria, we mailed: a study information letter, outcome questionnaire, and the date of their initial consultation visit. The initial consultation visit was assigned according to the date the referral was received, with no formalized prioritization system. Patients returned the questionnaire by mail in a pre-paid, addressed envelope. At the initial consult visit, the spine surgeon reassessed patients for eligibility anticipating further exclusion by criteria that could not be assessed on the initial referral. We invited all eligible patients to enter the study and written informed consent was obtained. A complete study rejection log was maintained. Patients waited for surgery on the individual operating surgeons wait list. The surgeons had equal access to operating room time.

Study Measures

We collected outcome measures at the initial referral (by mail), at initial consultation with the surgeon, immediately prior to surgery (preoperative), and 6, 12, and 24 months postoperatively. Primary outcome measures included the Medical Outcomes Study 36-Item Short Form Health Survey (SF-36) physical (PCS) and mental (MCS) component summary scores, and the Oswestry Disability Index (ODI). Secondary outcome measures included the symptom severity scale of the Zurich Claudication Questionnaire (ZCQ), the numeric-rating scale for back and leg pain, and satisfaction.

The SF-36 is a generic, multidimensional self-report health questionnaire and is validated when applied to the spine patient [12]. For the SF-36-PCS and MCS, higher scores imply better functioning. The ODI evaluates physical disability secondary to back and leg pain [13] and the ZCQ evaluates severity of spinal stenosis symptoms [14]. A higher score denotes worsening disability for both. The back and leg pain numeric rating scale range from 0 to 10, with lower scores indicating less severe symptoms [15]. Treatment satisfaction was also assessed.

Statistical Analysis

For primary analysis the short versus long wait was set according to the median surgical wait time from referral to surgery. Chi-square tests and unpaired t-tests were used to compare wait times, participant characteristics, patient satisfaction, and outcome scores, and to compare participants with missing data to those that participated in all visits. An analysis of covariance was conducted to assess change in mean HRQoL scores from referral to preoperative assessment by wait time, adjusting for age, surgeon, duration of symptoms and type of surgery. Analysis of covariance was conducted to assess the difference in change in mean preoperative to postoperative assessment at 6, 12 and 24 months by wait time, adjusting for age, surgeon, duration of symptoms, type of surgery, and the baseline outcome value. P values <0.05 were considered to be statistically significant.

Results

Population and baseline characteristics

One hundred and sixty-six patients were enrolled from the 1126 referrals initially considered during screening (Figure 1). The most frequent reasons for ineligibility were non-operative management (37.8 %) and improper spinal stenosis diagnosis/referral (24.0%).

The study population had a mean age of 66 years and mean BMI of 29 kg/m^2, with the majority being retired, and having one or more comorbidity (Table 1). The majority had classic neurogenic claudication (50.6 %) as well as back pain symptoms (74.7 %). Overall, patients had experienced symptoms for a median duration of 24 months (range 6 to 210 months) at the time of initial consultation with the spine surgeon. Most participants had central and lateral recess stenosis (56.6%), stenosis at L4 - L5 (59.3 %), and spondylolisthesis (57.8 %). The majority of participants underwent decompression and instrumented fusion (81.9 %; Table 2). At 2 years, 9.6 % of patients required a second procedure; fewer than half were for recurrent symptoms (same or adjacent level stenosis).

Patient follow-up was 85 % or higher for each visit. Characteristics of patients with missed visits were similar to the rest of the cohort except that they were more likely to be unemployed due to their back condition (4.5 % versus 16.7 %, $p = 0.021$), and have less severe leg pain at referral (8.4 ± 1.6 versus 7.7 ± 1.7, $p = 0.036$).

Wait times

In the overall cohort, the median time from referral to initial consultation was 177 days, and the time from consultation to surgery was 140 days (Table 3). The median wait time from referral to surgery was 349 days (range, 65 to 946 days) and the mean wait time was 361 ± 173 days. For analysis, we categorized wait time into short and long using the median wait of 12 months as the distinction.

Baseline and treatment characteristics compared between groups

The baseline characteristics of participants with short waits were not different from those with long waits (Table 1). Participants with a longer wait were more likely to undergo a multilevel fusion than those with shorter waits (30.6 % versus 14.9 %, $p = 0.015$; Table 2). Participants stayed in hospital for a median of 4 days (range 1-18 days) after surgery with no difference between wait time groups (p =

0.562). Deep wound infection occurred in 2.2 % of surgeries among participants with short waits and 2.7 % of surgeries among those with long waits (p = 0.787).

Effect of wait length on preoperative function

At referral, participants with shorter waits had poorer SF-36-MCS scores, more spine specific disability, and worse leg pain than those with long waits (p values for SF-36-MCS = 0.001, ODI = 0.040, leg pain = 0.026; Table 4). At the preoperative assessment the short wait cohort continued to have poorer mean scores on the SF-36-MCS (p=0.005) and ODI scales (p = 0.002), and tended to have greater leg pain (p = 0.007) than those with a long wait.

The mean change in outcome measures between baseline and preoperative assessments, adjusted for age, surgeon, duration of symptoms at consultation, and type of surgery, indicated some deterioration during the waiting period for all outcome measures assessed in both wait time cohorts (Table 5). However, comparisons between groups showed no evidence that the deterioration was affected by longer waits.

Effect of wait time on postoperative outcome

Comparisons of the mean difference in change from preoperative score to 6 and 12 months after surgery revealed that those that had a short wait experienced greater gains in improvement by 4.5 (95% CI, 0.3 to 8.7) and 5.7 (95% CI, 1.4 to 9.9) on the MCS scale, -8.5 (95% CI, -14.7 to -2.4) and -9.3 (95% CI, -15.1 to -3.6) on the ODI scale, and -1.4 (95% CI, -2.6 to -0.1) and -1.6 (95% CI, -3.0 to -0.3) on the intensity of leg pain index, respectively (Table 6). However by 24 months there was no longer a difference. We observed no significant differences in the mean change from preoperative score between short and long waits for SF-36-PCS, ZCQ, or back pain at 6, 12 or 24 months following surgery.

Wait time and patient satisfaction with treatment

There was no difference in satisfaction at the end of the preoperative waiting period between patients with short and long waits (6.8 % versus 12.5 %, $p = 0.398$, respectively). At 6 months following surgery the majority of patients were satisfied with the outcome of their surgical treatment (short, 89.4 % versus long, 84.7 %; $p = 0.481$). At 12 months following surgery more patients in the short wait group were satisfied with their treatment (89.3 % versus 75.0 %, $p = 0.010$). However, at 24 months following surgery a similar proportion of patients were satisfied in the short and long wait cohorts (80.9 % versus 75.0 %, $p = 0.447$, respectively).

Interpretation

In this prospective, observational study we examined whether a prolonged wait from the time of referral to surgery for lumbar degenerative spinal stenosis patients was detrimental to outcome. We found deterioration in outcome measures during the waiting period occurred irrespective of the length of waiting time, and that patients with a shorter wait experienced greater improvements during the first year after surgery. These finding are of particular relevance to the Canadian publically funded health care system, in which the median wait from referral to treatment by a neurosurgeon or orthopaedic surgeon is 26.6 and 39.6 weeks, respectively [16]. These waits are longer than the reported clinically reasonable wait, and likely under represent the actual wait as generally there are far fewer orthopaedic surgeons that have the subspecialized training necessary to practice spine surgery[16]. A survey of the Canadian Spine Society (completed by 86% of the membership) performed in 2005 judged the total wait of 24 weeks as an acceptable wait-time for elective spinal stenosis surgery [17]. The average wait time reported in our study fell well beyond this bench mark.

We did not confirm our hypothesis that length of wait time would correlate with a decline in function and quality of life during the waiting period. Possibly, because our patients were severely affected by

spinal stenosis in terms of their outcome measures, a "basement effect" prevented further distinction in their decline over time. Indeed, preoperative HRQoL was extremely poor when compared with mean age- and sex-matched Canadian population norms and were also worse than recently published cohorts of stenosis patients enrolled into other trials [4, 7, 18]. Other confounders include the heterogenous patient characteristics, and temporizing effects of non-operative treatment received during the wait. Interestingly, we identified poorer initial and preoperative mental health and function with greater leg pain scores among patients in the shorter wait time cohort. Although surgeons were blinded to the outcome scores, this finding is likely explained by surgeon selection bias whereby surgeons triaged patients for earlier surgery who were perceived to have greater disability and symptom severity. This speaks to the generalizability of our study as wait times are inherent to Canada's publically funded medical system and therefore surgeons must prioritize their wait list for those with greatest need.

Wait-time was found to have a profound effect on postoperative outcome. Despite a poorer preoperative score (which was controlled for in the post-operative analysis), patients with a shorter wait experienced greater improvements during the first year after surgery. Similarly, in 53 elective posterior lumbar surgery patients, Braybrook et al also reported that a longer wait was associated with less improvement in outcome following surgery [11]. In our study the greatest differences in improvement were in parameters relating to mental well-being (SF-36-CS), spine specific function (ODI) and leg pain. Although, we demonstrated significant improvement in both wait time groups, the delayed recovery of function and mental health demonstrated in the longer wait group likely reflects the advanced deconditioning that occurred secondary to prolonged immobility from spinal stenosis. Interestingly, the magnitude of improvement in the SF-36-PCS did not differ between wait time groups despite the difference demonstrated for ODI. We believe this is likely due to two factors. Firstly, the comorbidities common to many patients suffering from spinal degenerative disease have a negative impact on the improvement in outcome scores following surgery particularly on a general measure of

quality of life, such as the SF-36-PCS [19-21]. Secondly, that ODI and NRS leg pain measures are recognized to be much more sensitive measures of response to spine surgery then is the SF-36-PCS [22]. The similar magnitude of improvement seen in the ZCQ for both wait time groups is also not surprising as neurogenic claudication is quickly eliminated by decompressive surgery.

The duration of spinal stenosis symptoms as preoperative predictors of postoperative outcome is controversial [23]. Studies have found that symptom duration greater than one year is associated with a poorer surgical outcome [24-26], while other authors have refuted this association [27, 28]. However, many of these studies have been retrospective, sub-group post-hoc analysis, which relied on patient recall to define the pre-operative symptom duration. In contrast, strengths of our study were a prospective design, and inclusion of the entire spectrum of wait time commonly experienced in Canada; from the time of referral to surgery.

A limitation is that we did not randomize our patients to a shorter or longer wait. Therefore, surgeon bias, patient expectation, severity of the primary disease and secondary comorbidities were potential cofounders to our design. We did attempt to control for some of these potential biases in our analysis such as the difference between each surgeon's approach and surgical wait list, and the baseline outcome scores at presentation.

In conclusion, patients awaiting LDSS surgery experienced deterioration in function and HRQoL during the waiting period but the magnitude of the decline was not influenced by a shorter or longer wait. However, prolonged waits were associated with a delay in recovery during the first year after surgery. The wait times in our study reflect the reality faced by spinal surgeons and patients in Canada today and we feel our findings are generalizable to the Canadian patient and health care system. Our study suggests that strategies to reduce wait times to the clinically reasonable wait are urgently needed.

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Figure Legends

Figure 1. Flow diagram of exclusion, enrollment, and follow-up.

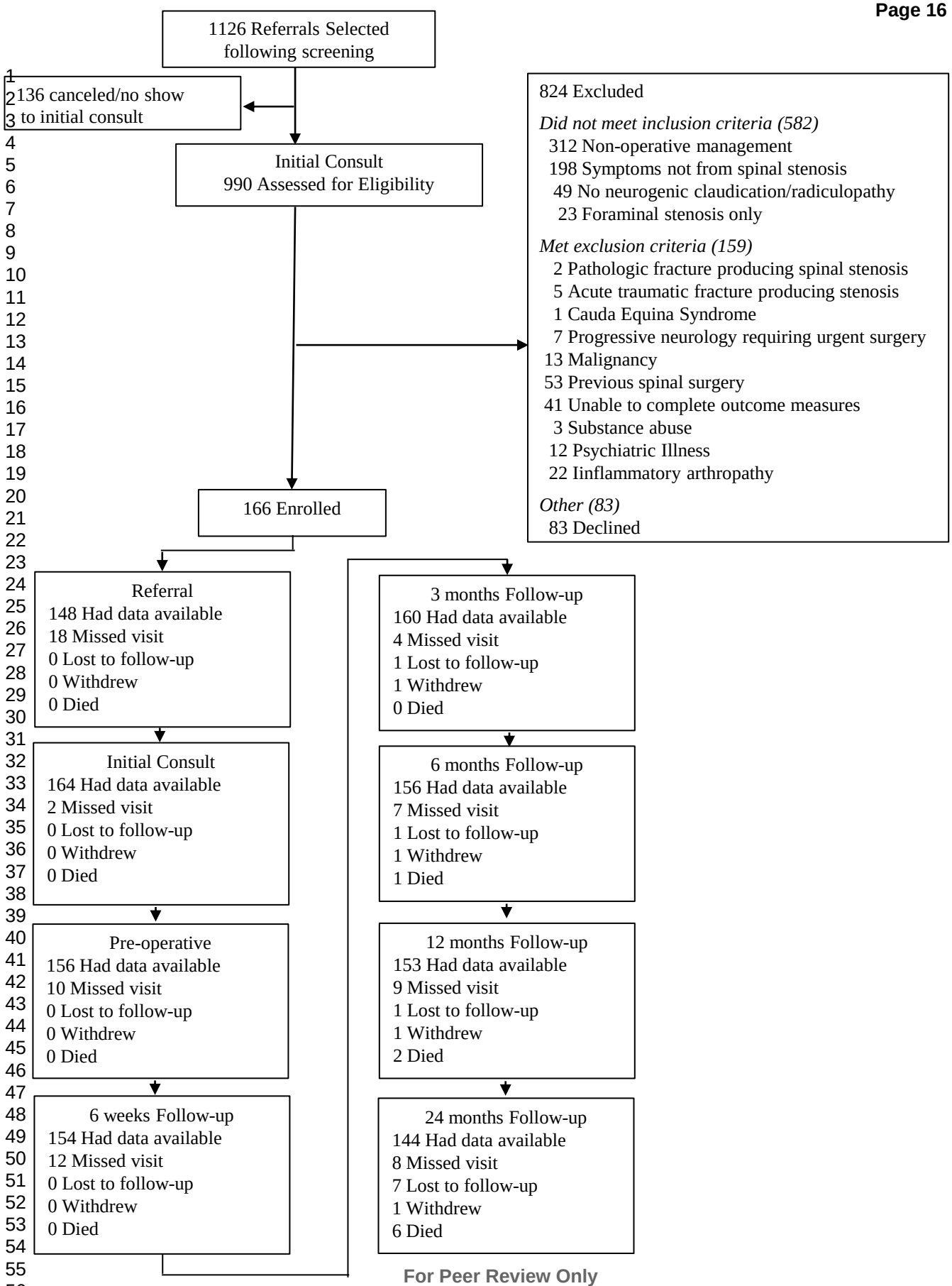

Table 1: Subject demographic characteristics and comparison between short and long wait times

Parameter	Total cohort n=166	Short ≤12 months n=94	Long >12 months n=72	*p* value
Age, mean ± SD, years	66.2 ± 9.0	66.1 ± 8.7	66.3 ± 9.3	0.854
BMI, mean ± SD, kg/m^2	29.0 ± 5.0	28.7 ± 4.5	29.4 ± 5.6	0.376
Women, n (%)	79 (47.6)	43 (45.7)	36 (50.0)	0.586
Smoker Status, n (%)				0.674
Never or no longer	145 (87.3)	83 (88.3)	62 (86.1)	
Yes	21 (12.7)	11 (11.7)	10 (13.9)	
Employment Status, n (%)				0.525
Not employed *(related to back pain)*	14 (8.4)	10 (10.6)	4 (5.6)	
Not employed *(unrelated to back pain)*	2 (1.2)	1 (1.1)	1 (1.4)	
Employed	39 (23.5)	18 (19.1)	21 (29.2)	
Retired	106 (63.9)	62 (66.0)	44 (61.1)	
Homemaker	5 (3.0)	3 (3.2)	2 (2.8)	
†Comorbidities, n (%)				
None	33 (11.9)	21 (22.8)	12 (16.2)	0.364
Hypertension	87 (31.1)	44 (47.8)	43 (58.1)	0.099
Diabetes	25 (8.9)	14 (15.2)	11 (14.9)	0.945
Osteoporosis	2 (0.7)	1 (1.1)	1 (1.4)	0.849
Heart disorder	27 (16.2)	15 (16.3)	12 (16.2)	0.902
Stomach disorder	21 (7.5)	13 (14.1)	8 (10.8)	0.602
Bowel or intestinal	2 (0.7)	1 (1.1)	1 (1.4)	0.849
Depression	7 (2.5)	5 (5.4)	2 (2.7)	0.419
Joint disorder	25 (7.9)	13 (14.1)	12 (16.2)	0.559
Thyroid disorder	15 (5.3)	9 (9.8)	6 (8.1)	0.782
Other	31 (11.1)	15 (16.3)	16 (21.6)	0.305
Unknown	9 (3.2)	5 (5.4)	4 (5.4)	0.947
Neurological Diagnosis, n (%)				0.633
Claudication	84 (50.6)	48 (51.1)	36 (50.0)	
Radiculopathy	10 (6.0)	7 (7.4)	3 (4.2)	
Both	72 (43.4)	39 (41.5)	33 (45.8)	
Primary Complaint, n (%)				0.129
Neurologic	42 (25.3)	28 (29.8)	14 (19.4)	
Neurologic and mechanical back pain	124 (74.7)	66 (70.2)	58 (80.5)	
Duration of symptoms from time of onset to initial consultation with the surgeon, median (range), months	24 (6 - 210)	24 (6 - 150)	30 (6 - 210)	0.166

Location of Stenosis				0.159
Central and lateral recess	94 (56.6)	55 (58.5)	39 (54.2)	
Central, foraminal, and lateral recess	38 (22.9)	16 (17.0)	22 (30.6)	
Lateral recess and foraminal	11 (6.6)	7 (7.4)	4 (5.6)	
Lateral recess	23 (13.9)	16 (17.0)	7 (9.7)	
†Level of stenosis, n (%)				
L2-3	15 (6.4)	5 (5.4)	10 (13.5)	0.056
L3-4	59 (25.0)	30 (31.9)	29 (40.2)	0.265
L4-5	146 (59.3)	81 (86.2)	65 (90.3)	0.420
L5-S1	17 (10.2)	6 (6.4)	11 (14.9)	0.061
Number of levels, n (%)				0.499
Single	113 (68.1)	66 (70.2)	47 (65.3)	
Multiple	53 (31.9)	28 (29.8)	25 (34.7)	
Spondylolisthesis, n (%)	96 (57.8)	55 (58.5)	41 (56.9)	0.840

†A patient could have more than one comorbidity or level of stenosis
BMI = body mass index

Table 2: Surgical treatment and peri-operative complications

Parameter	Total cohort n=166	Short ≤12 months n=94	Long >12 months n=72	*p* value
Type of Surgery, n (%)				0.138
Decompression without Fusion	26 (15.7)	12 (12.8)	14 (19.4)	
Decompression and Fusion				
Posterior instrumented fusion	49 (29.5)	25 (26.6)	24 (33.3)	
Posterior interbody fusion	87 (52.4)	53 (56.4)	34 (47.2)	
In-situ fusion	4 (2.4)	4 (4.3)	0 (0)	
Multilevel fusion, n (%)	35 (21.1)	14 (14.9)	22 (30.6)	0.015
Post-operative hospital length of stay, median (Range), days	4 (1-18)	4 (2-18)	4 (1-17)	0.562
†Surgical complications, n (%)				
Deep wound infection	4 (2.4)	2 (2.2)	2 (2.7)	0.787
Wound dehiscence	2 (1.2)	2 (2.2)	0 (0)	0.506
Dural Tear	5 (3.0)	3 (3.3)	2 (2.7)	0.877
Other	11 (6.6)	5 (5.3)	6 (8.1)	0.439
‡Additional Surgery, n (%)	16 (9.6)	9 (9.6)	7 (10.4)	0.975
2 yr postsurgical reoperations, n (%)				
Irrigation & debridement	7 (4.2)	4 (4.3)	3 (4.2)	0.978
Recurrent same level stenosis	4 (2.4)	2 (2.2)	2 (2.1)	0.787
Adjacent level stenosis	2 (1.2)	2 (2.2)	0 (0)	0.506
Other	3 (1.8)	1 (1.1)	2 (2.1)	0.411
Mortality at 2 year postoperative follow-up visit, n (%)	6 (3.6)	5 (5.3)	1 (1.4)	0.184

†A patient could have more than one postsurgical complication

‡ Additional surgery is within the first 2 years after the index surgery

Table 3: Surgical wait time periods

Time periods	Mean ± SD (days)	Median (range, days)
Time from primary care physician referral to the initial consultation with the surgeon	199 ± 132	177 (11 to 644)
Time from the initial consultation with the surgeon to surgery	162 ± 109	140 (16 to 645)
Time from primary care physician referral to surgery	361 ± 173	349 (65 to 946)

Table 4: Comparison of mean outcome scores at referral and immediately preoperative among patients with short (≤ 12 months) and long (>12 months) waits for surgery

	Mean score (and SD) at referral			Mean score (and SD) immediately preoperative		
Outcome Measure	Short ≤ 12 months	Long >12 months	*p* value	Short ≤ 12 months	Long >12 months	*p* value
SF-36 PCS	25.2 (4.9)	24.8 (5.8)	0.656	25.3 (5.1)	24.7 (6.5)	0.571
SF-36 MCS	42.3 (12.2)	49.1 (11.6)	0.001	41.3 (12.2)	46.7 (11.4)	0.005
ODI	46.8 (14.1)	42.1 (13.2)	0.040	53.0 (14.1)	46.2 (12.2)	0.002
ZCQ	3.7 (0.5)	3.6 (0.6)	0.238	3.8 (0.6)	3.6 (0.6)	0.056
Back pain	7.0 (2.4)	6.6 (2.2)	0.281	7.6 (2.3)	6.9 (2.4)	0.081
Leg pain	8.5 (1.3)	7.8 (2.0)	0.026	8.6 (1.4)	7.8 (2.4)	0.007

Abbreviations: SF-36, Medical Outcomes Study 36-Item Short Form Health Survey; PCS, physical component score; MCS mental component score; ODI, Oswestry Disability Index; ZCQ, symptom severity of the Zurich Claudication Questionnaire.

Mean summary scores are based on normative data and have a mean ± 50.
The ODI ranges from 1 to 100 and ZCQ ranges from 1 to 5, with lower scores indicating less severe symptoms
Average back pain and average leg pain range from 0 to 10, with lower scores indicating less severe symptoms

Table 5: Adjusted mean changes in outcome from referral until immediately preoperative among patients with short (≤ 12 months) and long (>12 months) waits for surgery

Outcome Measure	Mean change in score ≤ 12 months	Mean change in score >12 months	Mean Difference in Change (95% CI)	*p* value
SF-36 PCS, mean (SE)	-0.8 (0.9)	-1.3 (0.9)	0.5 (-1.5, 2.6)	0.601
SF-36 MCS, mean (SE)	-0.9 (1.5)	-1.6 (1.6)	0.6 (-2.8, 4.1)	0.715
ODI, mean (SE)	6.6 (1.5)	3.9 (1.6)	2.7 (-0.9, 6.2)	0.141
ZCQ, mean (SE)	0.2 (0.1)	0.2 (0.1)	0.01 (-0.2, 0.2)	0.880
Back pain, mean (SE)	0.7 (0.5)	0.6 (0.6)	0.1 (-1.0, 1.2)	0.840
Leg pain, mean (SE)	0.4 (0.3)	0.2 (0.4)	0.3 (-0.4, 1.0)	0.420

Values are adjusted for age, surgeon, duration of symptoms at consultation, and surgery type.

Abbreviations: SF-36, Medical Outcomes Study 36-Item Short Form Health Survey; PCS, physical component score; MCS mental component score; ODI, Oswestry Disability Index; ZCQ, symptom severity of the Zurich Claudication Questionnaire.

For SF-36 PCS and MCS a negative change score indicates deterioration. For ODI, ZCQ, Back pain and Leg pain a positive change score indicates deterioration.

Table 6: Changes in outcome from immediately preoperative assessment until 6, 12 and 24 months postoperative among patients with short (≤ 12 months) and long (>12 months) waits for surgery

	6 months			
Outcome Measure	Short ≤ 12 months	Long >12 months	Mean Difference in Change (95% CI)	*p* value
SF-36 PCS	12.3 (1.6)	10.1 (1.7)	2.2 (-1.6, 6.0)	0.252
SF-36 MCS	11.1 (1.8)	6.6 (1.8)	4.5 (0.3, 8.7)	0.035
ODI	-26.8 (2.7)	-18.2 (2.7)	-8.5 (-14.7, -2.4)	0.007
ZCQ	-1.6 (0.2)	-1.3 (0.2)	-0.3 (-0.6, 0.05)	0.094
Back pain	-5.0 (0.6)	-4.7 (0.6)	-0.4 (-1.6, 0.8)	0.557
Leg pain	-6.2 (0.6)	-4.9 (0.6)	-1.4 (-2.6, -0.1)	0.029
	12 months			
Outcome Measure	Short ≤ 12 months	Long >12 months	Mean Difference in Change (95% CI)	*p* value
SF-36 PCS	12.5 (1.6)	12.0 (1.8)	0.6 (-3.3, 4.5)	0.774
SF-36 MCS	11.1 (1.8)	5.6 (1.9)	5.7 (1.4, 9.9)	0.010
ODI	-30.2 (2.5)	-20.8 (2.5)	-9.3 (-15.1, -3.6)	0.002
ZCQ	-1.6 (0.2)	-1.5 (0.2)	-0.2 (-0.5, 0.2)	0.329
Back pain	-4.9 (0.6)	-4.3 (0.7)	-0.5 (-1.9, 0.7)	0.417
Leg pain	-6.8 (0.6)	-5.2 (0.7)	-1.6 (-3.0, -0.3)	0.019
	24 months			
Outcome Measure	Short ≤ 12 months	Long >12 months	Mean Difference in Change (95% CI)	*p* value
SF-36 PCS	10.6 (1.7)	11.2 (1.9)	-0.7 (-4.8, 3.3)	0.729
SF-36 MCS	9.6 (1.8)	5.9 (1.9)	3.7 (-0.6, 8.0)	0.089
ODI	-27.1 (2.4)	-22.2 (2.6)	-4.9 (-10.6, 0.9)	0.098
ZCQ	-1.4 (0.2)	-1.2 (0.2)	-0.2 (-0.6, 0.1)	0.213
Back pain	-5.1 (0.7)	-4.5 (0.7)	-0.6 (-1.9, 0.8)	0.429
Leg pain	-6.1 (0.6)	-4.9 (0.6)	-1.1 (-2.3, 0.1)	0.082

Values are adjusted for baseline score, age, surgeon, duration of symptoms, and surgery type.Abbreviations: SF-36, Medical Outcomes Study 36-Item Short Form Health Survey; PCS, physical component score; MCS mental component score; ODI, Oswestry Disability Index; ZCQ, symptom severity of the Zurich Claudication Questionnaire. For SF-36 PCS and MCS a positive change score indicates improvement. For ODI, ZCQ, Back pain and Leg pain a negative change score indicates improvement.