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Research Paper

# Factors Affecting the Outcome of Lumbar Canal Stenosis Surgery: A Two-year Follow-up Study

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## ABSTRACT

**Background:** Lumbar Canal Stenosis (LCS) is the most common reason for spinal surgery in older patients. Identifying factors influencing the outcome of surgical management is important in clinical research.

**Objectives:** This study aims to identify the factors affecting the outcome of surgical management for LCS.

**Materials & Methods:** This prospective non-randomized cohort study was conducted at the spine center of Imam Khomeini Hospital in Tehran, Iran from March 2017 to January 2019 on 135 patients with symptomatic LCS, confirmed by MRI. Clinical and functional outcomes were measured using the 12-Item Short form Health Survey (SF-12), Oswestry Disability Index (ODI) and Visual Analogue Scale (VAS) the day before surgery, and 12 and 24 months after surgery. Radiographical parameters was assessed by measuring lumbar lordosis, sacral slope, pelvic tilt and pelvic incidence.

**Results:** Of 135 patients, 120 completed the follow-up. Patients treated surgically had significant improvement in SF-12, ODI and VAS scores after 2 years of follow-up. Higher values of BMI (P=0.031), symptom duration >1 year (P=0.045 for SF-12, P=0.031 for ODI), and smoking (P=0.033 for SF-12, P=0.028 for ODI) were associated with poor outcome. Patients with higher pre-operative SF-12, ODI and VAS scores (P=0.007 for SF-12, P=0.003 for ODI, P=0.050 for VAS) and lower lumbar lordosis (P=0.055) showed significant improvement after surgery.

**Conclusion:** Patients with LCS showed significant improvement in outcomes after decompression surgery. Higher values of BMI, symptom duration >1 year, and smoking are associated with poor outcome, while higher pre-operative disability score and lower lumbar lordosis are associated with better outcome after surgery.

**Keywords:** Lumbosacral region; Surgery; Spine; Disease Management

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## Highlights

- All patients with lumbar canal stenosis had significant improvement after surgery
- Patients with higher Body Mass Index (BMI), longer duration of symptoms, history of psychiatric disease, and smoking had poor outcome after decompression surgery.
- Patients with higher preoperative disability scores and lower Lumbar Lordosis (LL) had better improvement and higher post-operative quality of life.

## Introduction

There is currently increasing trend in the quality of life and life expectancy. However, with aging, degenerative diseases such as Lumbar Canal Stenosis (LCS) become more prevalent. As the population ages, surgery is performed more frequently [1, 2]. LCS is characterized by compression of the neural elements, resulting in low back pain, radicular pain and neurogenic claudication along with weakness, numbness and tingling sensation [3]. Each year, high number of spinal decompression surgeries are performed worldwide [4]. LCS is the most common reason for spinal surgery in the elderly [5].

Improving outcome of surgical management for LCS is an important clinical issue. Spine surgeons would like to know which specific patient characteristics and clinical features influence the outcome of surgery. Decision making for the management of LCS demand strong coordination between physician and well-informed patient, with realistic expectation of surgical outcome. Despite the vast number of decompression surgeries for management of LCS, the influencing factors on the outcome have been poorly understood. This study aims to identify the factors influencing the outcome of spinal decompression surgery for LCS at a 2-year follow up.

## Material and Methods

This is a prospective non-randomized cohort study performed at the spine center of Imam Khomeini Hospital in Tehran, Iran. We prospectively enrolled 135 patients with symptomatic LCS from May 2017 to January 2019. Patients with radiographic evidence of LCS and not responding to conservative treatment for at least 6 weeks were included. Exclusion criteria were: cervical spinal canal involvement, history of vertebral fractures, metastasis and inflammatory diseases, and/or history of previous spinal surgery. The research was approved by the ethics committee of Tehran University of Medical Sciences. Patients meeting the inclusion criteria, were informed of the study objectives and methods and signed a written informed consent before entering the study. All patients had Magnetic Resonance Imaging (MRI) of lumbar spine at least 3 months before surgery which were examined by a musculoskeletal radiologist and senior surgeons. Patients were extensively examined before surgery, and both risks and benefits of surgical management were explained to them so that every patient can make an informed decision.

Data collection tool was a two-part questionnaire. The first part surveys demographic information such as age, gender, Body Mass Index (BMI), occupation, and past medical history. The second part included the 12-Item Short Form Health Survey (SF-12), the Visual Analog Scale (VAS) for measuring pai, and the Oswestry Disability Index (ODI). According to the Food and Drug Administration (FDA) recommendation, we considered 2.5-point difference for SF-12, 4-point difference for VAS, and 15-point difference for ODI to be clinically significant. Questionnaires were completed by the patients the day before surgery, and 12 and 24 months after surgery.

Surgical technique consisted of bilateral laminectomy and bilateral foraminotomies to decompress each nerve root. Posterior instrumentation and fusion were performed with preexisting degenerative spondylolisthesis or bilateral facet degeneration, and/or facet joints compromised as part of decompression. Following serial radiographs were taken for patients before surgery and 12 and 24 months after surgery: Standard lumbosacral anteroposterior, lateral and lateral flexion/extension radiographs. Spinopelvic alignments such as Pelvic Tilt (PT), Pelvic Incidence (PI), Lumbar Lordosis (LL) and Sacral Slope (SS) were measured before and after surgery (Figure 1). These parameters were used to evaluate radiographic outcome. Data were analyzed in SPSS software v. 24 using descriptive statistics (frequency, percentage, and mean), paired t-test, Pearson correla-

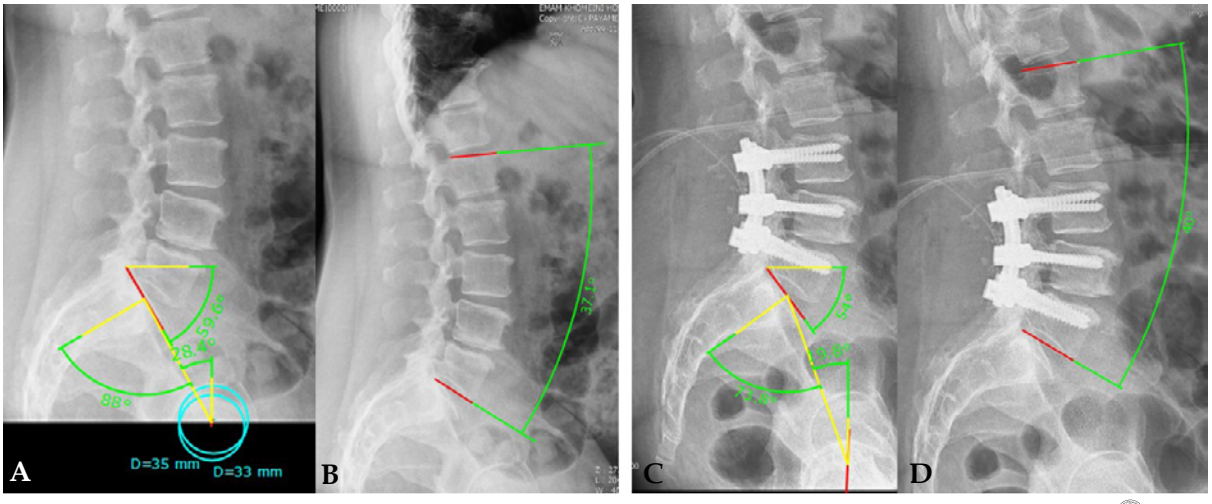


**Figure 1.** Lumbosacral spine X-rays in lateral view

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A: pre-operative PT (28°), PI (88°), SS (59°); B: pre-operative LL (37.1°); C: post-operative PT (9.8°), PI (73.8°), SS (54°); D: post-operative LL (40°)

tion test (to determine associations between age, gender, BMI and change in scores of VAS, SF-12, and ODI), and regression analysis (to identify the factors associated with changes in the VAS, SF-12, and ODI scores). The significance level was set at 0.05. In some cases, variables that were close to statistical significance were retained because of clinical interest.

## Results

Out of 135 patients, 120 completed the baseline and 2-year follow-up questionnaires (15 were lost to follow-up). Of 120 patients, 57 (47.5%) were female and 63 (52.5%) were male with mean age of 58.2 years; 43 (35.8%) had high-risk jobs (involving bending and lifting heavy objects, or long hour driving); 17 (14.2%) were smoking for at least 5 years; 32 (26.7%) had at least one underlying disease (diabetes mellitus, hypertension, abnormal lipid profile, or hypo-/hyperthyroidism), and 18 (15%) had a history of psychiatric diseases using some anti-depressant medications.

Patients treated surgically had a 3.5-point improvement in SF-12, 20-point improvement in ODI and 6-point improvement in VAS. There was no significant difference between decompression and fusion groups in radiographic parameters and SF-12, VAS or ODI scores at the 2-year follow-up phase comparing to the preoperative phase (Table 1). Age, gender, occupation, underlying disease, single-level/multiple-level laminectomy, fusion, type of LCS (central/lateral) were not significant factors (Table 2), but BMI (P=0.031), symptom duration >1 year (P=0.045 in SF-12, P=0.031 in ODI), smoking (>5 years) (P=0.033 in SF-12, P=0.028 in ODI), surgery

**Table 1.** Pre-operative and post-operative mean scores of VAS, SF-12, ODI, and radiographic parameters in each group

| Variables | Pre-operative Decompression | Pre-operative Fusion | Post-operative Decompression | Post-operative Fusion |
|---|---|---|---|---|
| ODI | 55 | 54 | 35 | 29 |
| SF-12 (physical component) | 36 | 35 | 42 | 40 |
| SF-12 (mental component) | 40 | 39 | 46 | 47 |
| VAS | 8 | 9 | 3 | 2 |
| LL | 41 | 32 | 42 | 48 |
| PT | 18 | 22 | 17 | 18 |
| SS | 39 | 45 | 41 | 49 |
| PI | 65 | 73 | 66 | 72 |

ODI: Oswestry Disability Index

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**Table 2.** Patient characteristics and factors correlation

| Characteristics | | No. (%) | P | | |
|---|---|---|---|---|---|
| | | | Association with SF-12 | Association with ODI | Association with VAS |
| Gender | Male | 57(47.5) | 0.438 | 0.716 | 0.896 |
| | Female | 63(52.5) | 0.438 | 0.716 | 0.896 |
| High-risk job | | 43(35.8) | 0.110 | 0.215 | 0.093 |
| Smoking | | 17(14.2) | 0.033* | 0.028* | 0.056* |
| Underlying disease | | 32(26.7) | 0.098 | 0.107 | 0.250 |
| History of psychiatric disease | | 18(15) | 0.036* | 0.046* | 0.060 |
| Symptom duration (>1 year) | | 73(60.8) | 0.045* | 0.031* | 0.055* |
| Multiple-level decompression | | 39(32.5) | 0.364 | 0.805 | 0.157 |
| Fusion | | 39(32.5) | 0.555 | 0.321 | 0.290 |
| Surgery time (>90 min) | | 49(41.9) | 0.051* | 0.049* | 0.065 |
| Central stenosis | | 34(28.3) | 0.438 | 0.411 | 0.521 |
| Lateral/far-lateral LCS | | 42(35.1) | 0.364 | 0.589 | 0.612 |
| Mixed LCS | | 44(36.6) | 0.099 | 0.150 | 0.199 |

* Significant at P<0.05.

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time (>90 min) (P=0.049 in ODI), and history of psychiatric disease (P=0.036 in SF-12, P=0.046 in Oswestry Disability Index (ODI)) were significant factors affecting the outcome of surgical management at a 2-year follow-up (Table 2, 3). Furthermore, preoperative disability score was associated with postoperative improvement in SF-12 and ODI (Table 3). Each one point increase in preoperative score was associated with 0.5 (P=0.007), 2.0 (P=0.003) and 0.5 (P=0.050) decrease in postoperative SF-12, ODI and VAS scores, respectively.

Four patients underwent reoperation for LCS at an adjacent level (two patients from each of the decompression and fusion groups). One patient from the decompression group and three patients from the fusion group had incision and drainage for postoperative wound infection or hematoma. None of patients had a cerebrospinal fluid leak after surgery, although four patients in the decompression group and two in the fusion group underwent dural tear repair.

**Table 3.** Regression coefficients

| Factors | β | P |
|---|---|---|
| Pre-operative SF-12 | -0.080 | 0.007 |
| Pre-operative ODI | -0.020 | 0.003 |
| Pre-operative VAS | -0.110 | 0.050 |
| BMI | 0.276 | 0.031 |
| History of Psychiatric disease | -0.101 | 0.005 |
| LL | -0.950 | 0.055 |

Negative beta values indicate an improvement, and positive beta values indicate a decline in scores.

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In radiographic studies, lower preoperative LL was found to be significantly associated with postoperative improvement (Increased SF-12 and ODI scores) in the fusion group at 2-year follow-up (Table 3). However, other radiographic parameters (PT, SS and PI) were not significantly correlated with the outcome of surgery (Table 1).

## Discussion

The LCS is the most common reason for spinal surgery in older patients [6]. Factors affecting the outcome of surgical management in LCS are not clear; only few studies have given a detailed reports [6-8], but the results are contradictory. Some studies have suggested that psychological factors are associated with poor outcome after surgical decompression [6, 9]. Other studies have found that older age, female, comorbidities, multiple-level laminectomy are associated with poor postoperative patient satisfaction [9-12]. They have some limitations and not clearly identified factors affecting the clinical outcome after spinal decompression surgery in patients with LCS.

In our study, a higher preoperative disability was associated with greater postoperative improvement in SF-12, ODI and VAS scores. Each one point increase in preoperative SF-12, ODI and VAS scores was associated with 0.5, 2.0 and 0.5 points improvement in postoperative scores, respectively. It seems that patients with greater disability have greater potential for recovery, whereas those with limited ability do not show major postoperative changes. Similar to our findings, Athiviraham et al. showed that patients with lower Rolland Morris score improved better after spinal decompression surgery [6]. However, earlier studies suggested that limitation in preoperative function is associated with decreased postoperative patient satisfaction [13].

Results of our study indicate that the history of psychiatric disease was associated with poor surgical outcome, correlating with SF-12 and ODI scores. However, it was subjectively assessed in our study. Patients may hide their psychiatric disease or may not reveal their anti-depressant use. Further studies should use broad assessment tools for its evaluation. Several studies have demonstrated similar association [6, 7, 9]. Sinikallio et al. evaluated the effect of depression on clinical outcomes of spinal surgery using the 21-item Beck Depression Inventory. They found strong association between using antidepressant medications and poor outcome of spinal decompression surgery [9]. Therefore, poor outcome and lower patient satisfaction after spinal decompression surgery in patients with history of psychiatric disease are expected.

We found that higher BMI were associated with poor clinical outcome, correlating with both SF-12 and ODI scores. We used regression model analysis to assess their correlation. However, future studies should obtain a cut-off BMI score, beyond which patients exhibit poor outcome after surgical decompression. Our results are consistent with several studies that have reported poor clinical outcome and decreased postoperative satisfactions in obese patients undergoing lumbar spine surgery [14, 15]. However, a recent systematic review on the impact of obesity on lumbar spine surgery outcome reported no significant difference. This study suggested that minimally invasive spine surgery offers comparable outcome between obese and non-obese patients [16].

Our study revealed that smoking was one of the factors affecting the outcome of LCS surgery. Smokers had lower pain (VAS) and poor functional scores (SF12 and ODI) in all time points and the difference was more significant after surgery. Assessment of smoking was subjective. Our results is consistent with previous studies indicating poor clinical outcome for smokers after surgery comparing to non-smokers [7]. A systematic review on the effects of smoking on spinal surgery reported increased rate of complications among smokers [8]. Our study did not show such association.

Among the radiographic parameters, we found LL as a factor correlated with the clinical outcome of the surgery. This association was found in the group of patients underwent instrumentation and fusion. We believe this association was due to reduced preoperative LL and restoration to normal parameters after surgery. Other spinopelvic alignments (PT, SS, PI) were not correlated with surgical outcome even in the fusion group. We found no other studies that have demonstrated such association.

Duration of symptoms more than one year was associated with poor outcome of surgical management based on the ODI (P=0.049) and SF12 (P=0.051) scores. This indicates that both pain level and duration of symptoms can affect the clinical outcome of surgical management in LCS. Patients with longer duration of symptoms showed poor clinical outcome. Leslie et al. also demonstrated the association of symptoms duration with standard outcome measures after spinal decompression surgery [17]. Unlike previous studies, we found that factors such as underlying disease, female gender, anatomic location of canal stenosis or multiple-level laminectomy were not associated with the outcome of surgical management, at least not after two years of follow-up. A broad understanding of factors influencing outcome of surgery may require longer follow-up period. Our study may be used as basis for future prospective studies.

## Conclusion

In patients with LCS, higher BMI, longer duration of symptoms, history of psychiatric disease, and smoking are associated with poor outcome after spinal decompression surgery regarding radiological parameters and quality of life. Those with higher preoperative disability scores (ODI and SF-12) and lower lumbar lordosis have better improvement and higher quality of life after surgery.

## Ethical Considerations

### Compliance with ethical guidelines

All study procedures were in compliance with the ethical guidelines of the Declaration of Helsinki 2013. This study was approved by the Ethics Committee of Tehran University of Medical Sciences (Code: IR.TUMS.IKHC.REC.1398.269).

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### Authors' contributions

Conceptualization: Babak Mirzashahi, Mohammad Zarei, Saied Besharaty; Methodology and Validation: Babak Mirzashahi, Saied Besharaty, Mina Bagheri, Sadegh Hasani Satehi; Formal Analysis and Investigation: Saied Besharaty, Sadegh Hasani Satehi; Resources, Data Curation, Review & Editing: Furqan Mohammed Yaseen Khan, Amir Kian Moaveni; Original Draft Preparation: Furqan Mohammed Yaseen Khan, Nima Bagheri; Supervision and Project Administration: Barak Mirzashahi, Mohammed Zarei

### Conflict of interest

The authors report no conflict of interest.

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## References

[1] Ciol MA, Deyo RA, Howell E, Kreif S. An assessment of surgery for spinal stenosis: Time trends, geographic variations, complications, and reoperations. J Am Geriatr Soc. 1996; 44(3):285-90. [PMID]

[2] Amundsen T, Weber H, Nordal HJ, Magnaes B, Abdelnoor M, Lilleås F. Lumbar spinal stenosis: Conservative or surgical management? A prospective 10-year study. Spine. 2000; 25(11):1424-35. [PMID]

[3] Davis H. Increasing rates of cervical and lumbar spine surgery in the United States, 1979-1990. Spine. 1994; 19(10):1117-23 [PMID]

[4] Deyo RA, Mirza SK. Trends and variations in the use of spine surgery. Clin Orthop Relat Res. 2006; 443:139-46. [PMID]

[5] Weinstein JN, Tosteson TD, Lurie JD, Tosteson AN, Blood E, Hanscom B, et al. Surgical versus nonsurgical therapy for lumbar spinal stenosis. N Engl J Med. 2008; 358(8):794-810. [PMID] [PMCID]

[6] Athiviraham A, Wali ZA, Yen D. Predictive factors influencing clinical outcome with operative management of lumbar spinal stenosis. Spine J. 2011; 11(7):613-7. [PMID]

[7] Chapin L, Ward K, Ryken T. Preoperative depression, smoking, and employment status are significant factors in patient satisfaction after lumbar spine surgery. Clin Spine Surg. 2017; 30(6):E725-32 [PMID]

[8] Jackson KL 2nd, Devine JG. The effects of smoking and smoking cessation on spine surgery: A systematic review of the literature. Glob Spine J. 2016; 6(7):695-701. [DOI:10.1055/s-0036-1571285] [PMID] [PMCID]

[9] Sinikallio S, Aalto T, Airaksinen O, Lehto SM, Kröger H, Viinamäki H. Depression is associated with a poorer outcome of lumbar spinal stenosis surgery: A two-year prospective follow-up study. Spine. 2011; 36(8):677-82 [PMID]

[10] Katz JN, Lipson SJ, Brick GW, Grobler LJ, Weinstein JN, Fossel AH, et al. Clinical correlates of patient satisfaction after laminectomy for degenerative lumbar spinal stenosis. Spine. 1995; 20(10):1155-60. [PMID]

[11] Iguchi T, Kurihara A, Nakayama J, Sato K, Kurosaka M, Yamasaki K. Minimum 10-year outcome of decompressive laminectomy for degenerative lumbar spinal stenosis. Spine. 2000; 25(14):1754-9. [PMID]

[12] Mariconda M, Zanforlino G, Celestino GA, Brancaleone S, Fava R, Milano C. Factors influencing the outcome of degenerative lumbar spinal stenosis. J Spinal Disord. 2000; 13(2):131-7. [PMID]

[13] Toyone T, Tanaka T, Kato D, Kaneyama R, Otsuka M. Patients' expectations and satisfaction in lumbar spine surgery. Spine. 2005; 30(23):2689-94. [PMID]

[14] Patel N, Bagan B, Vadera S, Maltenfort MG, Deutsch H, Vaccaro AR, et al. Obesity and spine surgery: Relation to perioperative complications. J Neurosurg Spine. 2007; 6(4):291-7. [PMID]

[15] Garcia RM, Messerschmitt PJ, Furey CG, Bohlman HH, Cassinelli EH. Weight loss in overweight and obese patients following successful lumbar decompression. J Bone Joint Surg Am. 2008; 90(4):742-7. [PMID]

[16] Goyal A, Elminawy M, Kerezoudis P, Lu VM, Yolcu Y, Alvi MA, et al. Impact of obesity on outcomes following lumbar spine surgery: A systematic review and meta-analysis. Clin Neurol Neurosurg. 2019; 177:27-36. [PMID]

[17] Ng LC, Tafazal S, Sell P. The effect of duration of symptoms on standard outcome measures in the surgical treatment of spinal stenosis. Eur Spine J. 2007; 16(2):199-206. [PMID]