J Turk Spinal Surg 2023;34(4):143-148
DOI: 10.4274/jtss.galenos.2023.29494



# FACTORS CAUSING COMPLICATIONS AND DISABILITY IN PATIENTS OPERATED FOR SPINAL STENOSIS WITH POSTERIOR DECOMPRESSION, INSTRUMENTATION AND FUSION

Mehmet Akdemir[1], Ahmet Cemil Turan[2], Ali İhsan Kılıç[3], Cengizhan Kurt[3], Sercan Çapkın[3]

[1]Private İzmir Ekol Hospital, Clinic of Orthopedics and Traumatology, İzmir, Turkey
[2]Private Clinic, Clinic of Orthopedics and Traumatology, İzmir, Turkey
[3]İzmir Bakırçay University Faculty of Medicine, Department of Orthopedics and Traumatology, İzmir, Turkey

ABSTRACT

**Objective:** Spinal stenosis, characterized by spinal canal narrowing and neural structure compression, leads to debilitating symptoms and impacts quality of life. Surgical interventions for spinal stenosis are on the rise because of an aging population and advancing surgical techniques. However, complications can undermine outcomes. Understanding the factors contributing to complications is crucial for optimizing outcomes. This study aimed to identify complications and disability factors in patients undergoing posterior spinal instrumentation for spinal stenosis.

**Materials and Methods:** Data from patients who underwent surgery for degenerative spinal stenosis were retrospectively analyzed. Factors including age, gender, cage usage, instability, and preoperative mobility were evaluated. Complications, including infection and adjacent segment degeneration, were documented. Statistical analysis was performed to identify correlations and significant differences.

**Results:** Sixty four patients were included in the study. 79.7% of the patients were women. The mean follow-up time was 46.56 months. The study revealed correlations between preoperative mobility status and infection rates, with immobile patients at higher risk (p=0.034). Gender disparities were noted, with female patients exhibiting more functional disability (Oswestry score female 12.41, male 7.00, p=0.044). Cage usage correlated with worse outcomes (p=0.007), and spinal instability was associated with poorer functional scores (p=0.015). Complications were observed in 13 (20.3%) patients. Infection was detected in 5 patients, postoperative neurodeficiency in 2 patients, re-operation in 13 patients (20.3%), and adjacent segment degeneration in 9 patients (14.1%).

**Conclusion:** Despite limitations, this study provides valuable insights into factors influencing complications and disability in spinal stenosis surgery. Tailoring interventions based on these findings could enhance patient outcomes.

**Keywords:** Spinal stenosis, posterior spinal instrumentation, cage usage, spinal instability

## INTRODUCTION

Spinal stenosis is a degenerative condition characterized by the narrowing of the spinal canal, resulting in compression of neural structures and subsequent symptoms such as pain, numbness, and functional limitations[1,2]. It is a common spinal disorder, particularly prevalent in the aging population, and can significantly impact an individual's quality of life[3,4].

With the increasing aging population and advances in surgical techniques, the number of patients undergoing surgical interventions for spinal stenosis has been steadily rising[5-7]. However, despite the effectiveness of surgical treatments, complications can arise, leading to prolonged hospital stays, increased healthcare costs, and potentially worse patient outcomes[8-10].

Understanding the factors contributing to complications and disability in patients operated for spinal stenosis is of paramount importance for optimizing surgical outcomes and improving patient care. By identifying these factors, healthcare providers can implement strategies to minimize complications and enhance patient recovery[4,9].

The aim of this study is to determine the factors causing complications and disability in patients who underwent surgical intervention, specifically posterior spinal instrumentation, for spinal stenosis. This investigation will shed light on the potential risk factors associated with unfavorable postoperative outcomes, allowing for tailored management approaches and improved patient outcomes.

The findings of this study have the potential to guide clinical decision-making and optimize patient outcomes in spinal stenosis surgery. By identifying the factors associated

**Address for Correspondence:** Mehmet Akdemir, Private İzmir Ekol Hospital, Clinic of Orthopedics and Traumatology, İzmir, Turkey
**Phone:** +90 505 525 03 99 **E-mail:** akdemir_mehmet@yahoo.com **Received:** 11.08.2023 **Accepted:** 06.09.2023
**ORCID ID:** orcid.org/0000-0001-9638-4907

with complications and disability, healthcare providers can implement targeted interventions, such as infection prevention strategies, personalized rehabilitation programs, and meticulous evaluation of spinal stability, to minimize adverse events and enhance patient recovery.

## MATERIALS AND METHODS

After obtaining ethical approval, patients who underwent posterior spinal instrumentation and fusion due to degenerative spinal stenosis were retrospectively selected from the archive. This study was approved by the İzmir Bakırçay University Ethics Committee (decision no: 1139, date: 26.07.2023).

Patients with unresponsive conservative treatment, severe pain, decreased walking distance, and neurological deficits underwent surgery. Detailed medical history, physical examination, neurological evaluation, plain radiographs, and magnetic resonance imaging (MRI) were performed before surgical intervention. Patients with congenital stenosis, pediatric cases, spinal stenosis due to tumor-related causes, those treated with anterior instrumentation, and those who underwent only release without fusion were excluded from the study. Patients with spinal stenosis caused by factors such as recurrent or initial disc herniation, facet arthrosis, thickened ligamentum flavum, degenerative spondylolisthesis, and foraminal narrowing were included in the study. Reasons for preferring posterior instrumentation and fusion as a surgical technique; history of failed disc surgery, instability, advanced facet joint degeneration, multiple segment stenosis, and need for bilateral laminectomy. All patients included in the study had degenerative instability. We did not have any traumatic, isthmic, congenital or iatrogenic instability patients. There was no iatrogenic instability in patients who had previously had failed disc surgery and who we applied posterior spinal instrumentation. Some of these patients already had instability before disc surgery.

Patient-specific data including age, gender, follow-up duration, levels of operation, use of cages, presence of instability (spondylolisthesis), file information, preoperative MRI, plain radiographs, and postoperative plain radiographs along with computed tomography (CT) scan for screw placement verification were collected. Neurological status and mobility grades were recorded based on file information before surgery. Preoperative neurological statuses were categorized as weakness and severe pain (able to walk), mobilization with wheelchair assistance (less pain), inability to walk with severe pain, and presentation with severe pain and cauda equina syndrome. Postoperative clinical scoring was conducted using the oswestry disability index and visual analog scale (VAS) for pain assessment. Complications such as deep infection, iatrogenic neurological deficits, re-operation, adjacent segment degeneration, and non-fusion were defined, documented, and registered.

Surgically, patients were operated on in a prone position under general anesthesia. Prophylactic antibiotic therapy (1 g cefazolin sodium) was administered to the patients. A posterior longitudinal incision was made to access the subcutaneous tissues. Paravertebral muscles around the spinous processes were dissected after passing through the fascia. Facet joints were exposed for visualization. Hemostasis was achieved using cautery or bipolar methods. Segment identification was aided by fluoroscopy. Pedicle screws were placed using fluoroscopic guidance at appropriate levels. Laminectomy was performed as necessary for affected regions. Procedures such as hypertrophic ligamentum flavum removal, excision of extruded disc material (if present), release of dural adhesions (if present), excision of facet joints, and removal of bone compressions (if present) were carried out. Wide decompression was preferred in revision cases with dural adhesions and in cases of stenosis in which more than one segment is affected. Cages were placed for posterior lumbar interbody fusion in segments with instability. Polyaxial pedicle screws were fixed using pre-bent rods. Intermediate connectors were placed. Allografts and autografts were mixed and placed in posterolateral corners after obtaining bone grafts from the patient. After hemostasis, the wound was closed with a single Hemovac drain (Figure 1).

Postoperative plain radiographs and CT scans for screw placement verification were obtained. In patients, the presence of fusion was monitored through anteroposterior and lateral direct radiographs. Patients were assisted to sit on the bedside on the first postoperative day. In-bed exercises were initiated immediately. Patients in stable condition were mobilized with a brace at 24-36 hours postoperatively. Patients with improved general conditions were discharged with palliative pain management. Wound care continued for two weeks. During

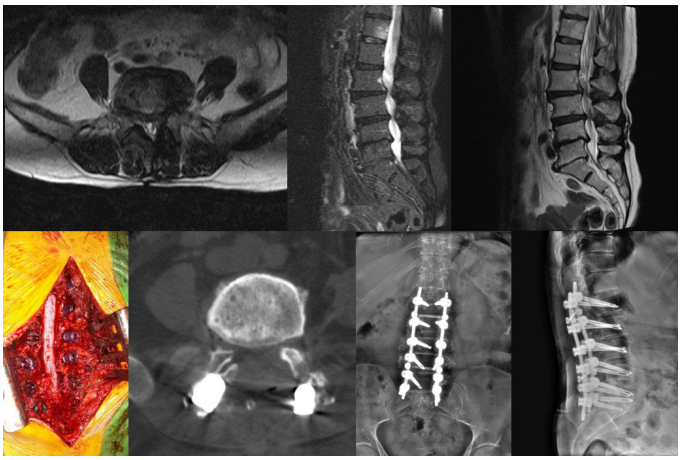

**Figure 1.** Widening of the stenosis in the spinal canal with laminectomy and application of posterior spinal instrumentation due to recurrence and severe spinal stenosis in a patient who had previously undergone disc surgery (the AP diameter of the canal is 4 mm preoperavely, 13 mm postoperatively)
AP: Anteroposterior

this time, patients continued home exercises. Monthly follow-up with plain radiographs was initiated after the first month. Active physical therapy was started after the first month.

### Statistical Analysis

Statistical analysis was done with SPSS program. Conformity of numerical data to normal distribution was done with Shapiro-Wilk test. T-test was used when there was normal distribution between two independent groups, Mann-Whitney U test was used in cases where there was normal distribution between two independent groups. Pearson or Spearman test was used as correlation test $p<0.05$ was accepted as statistical significance level.

## RESULTS

Sixty-four patients with clinical follow-up were included in the study. The mean age of the patients was 62 (34-81). There were 51 (79.7%) female and 13 (20.3%) male patients. mean follow-up times were 48.56 (12-134) months. Mean VAS scores were 3.22 (1-9). The mean oswestry scores were 11.31 (2-45) (Table 1).

Thirteen (20.3%) patients were operated on because of shortened walking distance, 35 (54.7%) patients with neurological findings, 6 (9.4%) patients with acute-subacute cauda equina, and 10 (15.6%) patients who were in a wheelchair for long periods of time (Table 1).

Fifteen of the patients had previously undergone discectomy for disc herniation. Cage was applied to 25 patients (39.1). There was instability in 24 patients (37.5%). The average number of levels was 4.42 (2-7) (Table 1).

Complications were seen in a total of 13 (20.3%) patients. Infection was detected in 5 patients, postoperative neurodeficiency in 2 patients, re-operation in 13 patients (20.3%), and adjacent segment degeneration in 9 patients (14.1%) (Table 1).

In the comparison of categorical data with each other (sex, disc surgery, cage use, instability and preoperative mobilization-neurological status and complication, infection, adjacent segment degeneration, reoperation rate and neurological complication); there was a significant difference between preoperative mobilization status and infection ($p=0.034$, Pearson chi-square test). There was no statistically significant difference between gender, disc surgery, cage use, instability rates and complication rates ($p>0.050$, chi-square test) (Table 2).

According to the Spearman correlation test, a significant correlation was found between age and of oswestry score and the number and stabilization levels ($p=0.023$ and $<0.001$). Naturally, VAS scores and oswestry scores were also correlated with each other ($p<0.001$).

When the patients were divided into two groups according to gender, disc surgery status, cage use, instability and presence of complications, and the VAS and oswestry scores were compared, the oswestry score was found to be lower in female patients ($p=0.044$, Mann-Whitney U test). Oswestry scores of the patients using cage were lower ($p=0.07$). Oswestry and

**Table 1.** General information of demographics, clinical results and complications of the patients

| Demographic, radiologic and clinical results | | Number/mean | SD/% |
|---|---|---|---|
| Age (years) | | 62.00 | 11,445 SD |
| Gender | Male | 13 | 20.3% |
| | Female | 51 | 79.7% |
| Follow-up time (months) | | 46.56 | 31,488 SD |
| Preop lumbar disc operation | | 15 | 23.4% |
| Spinal enstrumantation levels (mean) | | 4.42 | 2-7 (range) |
| Cage use | | 25 | 39.1% |
| Instability | | 24 | 37.5% |
| Preoperative neurological status | Weakness and severe pain | 35 | 54.7% |
| | In a wheelchair | 10 | 15.6 % |
| | Inability to walk and severe pain | 13 | 20.3% |
| | Cauda equina syndrome | 6 | 9.4% |
| Oswestry score | | 11.31 | 10,711 SD |
| VAS score | | 3.22 | 2,119 |
| Complication | | 13 | 20.3% |
| Infection | | 5 | 7.8% |
| Re-operation | | 13 | 20.3% |
| Non-union | | 1 | 1.6% |
| Adjent segment degeneration | | 9 | 14.1% |

SD: Standard deviation, VAS: Visual analog scale

VAS scores were significantly worse in patients with instability (p=0.05 and 0.015). Again, the clinical scores of the patients who developed complications (oswestry and VAS) were worse than those who did not (p<0.001 and 0.002) (Table 3).

## DISCUSSION

The present study aimed to identify the factors contributing to complications and disability in patients who underwent posterior spinal instrumentation for spinal stenosis. The findings provide valuable insights into the causes of complications, functional outcomes, and potential risk factors associated with this surgical intervention.

One notable finding is the association between preoperative mobilization status and infection rates. The study demonstrates that patients who were immobile for extended periods before the operation, such as those reliant on wheelchairs, had a higher incidence of postoperative infections. This aligns with previous research emphasizing the importance of optimizing patient mobility and minimizing preoperative immobilization to reduce the risk of surgical site infections[11,12].

Gender differences were also observed in terms of pain and disability. Female patients exhibited higher oswestry scores, indicating greater functional disability, compared to male patients. This finding is consistent with other studies that have reported higher pain levels and poorer functional outcomes in female patients undergoing spinal surgeries[13,14]. Further investigation is warranted to explore the underlying mechanisms contributing to these gender disparities and to develop tailored management strategies.

Additionally, the utilization of interbody fusion with a cage was associated with increased pain and disability, as reflected in the oswestry scores. This finding suggests that cage usage may be linked to poorer functional outcomes in patients undergoing spinal stenosis surgery. While the present study did not delve into the specific reasons for this association, it is possible that patient-related factors, such as instability, revision cases or increased surgical time, may influence postoperative pain and disability[15]. Future studies should delve deeper into this relationship to guide the selection and optimization of surgical approaches[16].

Another significant factor impacting outcomes was spinal instability, which was associated with worse functional scores. This finding aligns with the existing literature, which highlights the negative impact of instability on clinical outcomes following spinal surgery[17,18]. Spinal instability may lead to altered biomechanics, increased stress on adjacent segments, and compromised surgical outcomes[19]. Thus, meticulous

**Table 2.** Presentation of significance (p-values) obtained from cross-tables of demographic data and complication rates in table format

| | Complication | Infection | Neurological complication | Re-operation | Adjacent segment degeneration |
|---|---|---|---|---|---|
| Gender | 0.439* | 0.574* | 1,000* | 0.439* | 0.185* |
| Preop LDH operation | 0.482* | 0.329* | 1,000* | 0.482* | 0.427* |
| Cage use | 0.492** | 1,000* | 0.516* | 0.492** | 0.463* |
| instability | 0.751* | 0.355* | 1,000* | 1,000* | 0.464* |
| Preoperative neurological status | 0.170** | **0.034**** | 0.535** | 0.514** | 0.347** |

*Fisher's exact test, **Pearson chi-square test, LDH: Lumbar disc hernia

**Table 3.** Investigation of the relationship between oswestry and VAS scores using the Mann-Whitney U test in the presence of variables such as age, instability, use of cage, prior disc herniation surgery, and overall complications

| | | Oswestry | SD | p value* | VAS score | SD | p value* |
|---|---|---|---|---|---|---|---|
| Gender | Female | 12.41 | 11.204 | **0.044** | 3.39 | 2.201 | 0.181 |
| | Male | 7.00 | 7.348 | | 2.54 | 1.664 | |
| Instability | Yes | 9.04 | 11.161 | 0.050 | 2.58 | 2.125 | **0.015** |
| | No | 12.68 | 10.334 | | 3.60 | 2.048 | |
| Cage usage | Yes | 7.88 | 8.555 | **0.007** | 2.60 | 1.756 | 0.053 |
| | No | 13.51 | 11.457 | | 3.62 | 2.255 | |
| Previous lumbar disc surgery | Yes | 11.53 | 9.680 | 0.534 | 3.47 | 1.995 | 0.409 |
| | No | 11.24 | 11.101 | | 3.14 | 2.170 | |
| Complication | Yes | 23.77 | 14.538 | **<0.001** | 5.54 | 2.989 | **0.002** |
| | No | 8.14 | 6.573 | | 2.63 | 1.326 | |

*Mann-Whitney U test, SD: Standard deviation, VAS: Visual analog scale

evaluation and appropriate management of spinal instability are crucial for optimizing patient outcomes in spinal stenosis surgery.

Regarding complications, the study reported an overall complication rate of 20.3%. Infection was the most frequent complication, followed by re-operation and adjacent segment degeneration. These findings are consistent with the known complications associated with spinal stenosis surgery[8,11]. The identification of these complications emphasizes the importance of comprehensive perioperative care, including stringent infection control measures and close postoperative monitoring, to minimize the incidence and impact of these adverse events.

### Study Limitations

It is important to acknowledge the limitations of this study. The retrospective design and relatively small sample size may limit the generalizability of the findings. Future prospective studies with larger cohorts are warranted to validate and expand upon these results. Additionally, factors such as patient comorbidities, surgical techniques, and implant characteristics were not extensively explored in this study and may influence outcomes in spinal stenosis surgery. Further investigations considering these factors are necessary to provide a more comprehensive understanding of the relationship between patient characteristics, surgical variables, and clinical outcomes.

## CONCLUSION

This study highlights several important factors associated with complications and disability in patients undergoing posterior spinal instrumentation for spinal stenosis. Preoperative mobilization status, gender, cage usage, and spinal instability were identified as significant factors impacting postoperative pain and functional outcomes. These findings contribute to our understanding of the complexities of spinal stenosis surgery and emphasize the need for personalized patient management strategies. By optimizing patient mobility, considering gender-specific factors, and carefully evaluating and addressing spinal instability, healthcare professionals can strive to improve surgical outcomes and enhance the overall quality of care for patients with spinal stenosis.

### Ethics

**Ethics Committee Approval:** This study was approved by the İzmir Bakırçay University Ethics Committee (decision no: 1139, date: 26.07.2023).

**Informed Consent:** Retrospective study.

**Peer-review:** Externally peer-reviewed.

### Authorship Contributions

Surgical and Medical Practices: M.A., A.C.T., A.İ.K., C.K., S.Ç., Concept: M.A., A.C.T., A.İ.K., C.K., S.Ç., Design: M.A., A.C.T., A.İ.K., C.K., S.Ç., Data Collection or Processing: M.A., A.C.T., A.İ.K., C.K., S.Ç., Analysis or Interpretation: M.A., A.C.T., A.İ.K., C.K., S.Ç., Literature Search: M.A., A.C.T., A.İ.K., C.K., S.Ç., Writing: M.A., A.C.T., A.İ.K., C.K., S.Ç.

**Conflict of Interest:** The authors have no conflicts of interest to declare.

**Financial Disclosure:** The authors declared that this study received no financial support.

## REFERENCES

1. Deyo RA, Mirza SK, Martin BI, Kreuter W, Goodman DC, Jarvik JG. Trends, major medical complications, and charges associated with surgery for lumbar spinal stenosis in older adults. JAMA. 2010;303:1259-65.
2. Patel EA, Perloff MD. Radicular Pain Syndromes: Cervical, Lumbar, and Spinal Stenosis. Semin Neurol. 2018;38:634-9.
3. Jensen MC, Brant-Zawadzki MN, Obuchowski N, Modic MT, Malkasian D, Ross JS. Magnetic resonance imaging of the lumbar spine in people without back pain. N Engl J Med. 1994;331:69-73.
4. Katz JN, Stucki G, Lipson SJ, Fossel AH, Grobler LJ, Weinstein JN. Predictors of surgical outcome in degenerative lumbar spinal stenosis. Spine (Phila Pa 1976). 1999;24:2229-33.
5. Marquez-Lara A, Nandyala SV, Fineberg SJ, Singh K. Current trends in demographics, practice, and in-hospital outcomes in cervical spine surgery: a national database analysis between 2002 and 2011. Spine (Phila Pa 1976). 2014;39:476-81.
6. Deyo RA, Gray DT, Kreuter W, Mirza S, Martin BI. United States trends in lumbar fusion surgery for degenerative conditions. Spine (Phila Pa 1976). 2005;30:1441-5; discussion 1446-7.
7. Sirvanci M, Bhatia M, Ganiyusufoglu KA, Duran C, Tezer M, Ozturk C, et al. Degenerative lumbar spinal stenosis: correlation with Oswestry Disability Index and MR imaging. Eur Spine J. 2008;17:679-85.
8. Epstein NE. Complications due to the use of BMP/INFUSE in spine surgery: The evidence continues to mount. Surg Neurol Int. 2013;4(Suppl 5):S343-52.
9. Tang H, Zhu J, Ji F, Wang S, Xie Y, Fei H. Risk factors for postoperative complication after spinal fusion and instrumentation in degenerative lumbar scoliosis patients. J Orthop Surg Res. 2014;9:15.
10. Machado GC, Ferreira PH, Harris IA, Pinheiro MB, Koes BW, van Tulder M, et al. Effectiveness of surgery for lumbar spinal stenosis: a systematic review and meta-analysis. PLoS One. 2015;10:e0122800.
11. Zhang X, Liu P, You J. Risk factors for surgical site infection following spinal surgery: A meta-analysis. Medicine (Baltimore). 2022;101:e28836.
12. Liu JM, Deng HL, Chen XY, Zhou Y, Yang D, Duan MS, et al. Risk Factors for Surgical Site Infection After Posterior Lumbar Spinal Surgery. Spine (Phila Pa 1976). 2018;43:732-7.
13. Kobayashi Y, Ogura Y, Kitagawa T, Yonezawa Y, Takahashi Y, Yasuda A, et al. Gender Differences in Pre- and Postoperative Health-Related Quality of Life Measures in Patients Who Have Had Decompression Surgery for Lumbar Spinal Stenosis. Asian Spine J. 2020;14:238-44.
14. MacLean MA, Touchette CJ, Han JH, Christie SD, Pickett GE. Gender differences in the surgical management of lumbar degenerative disease: a scoping review. J Neurosurg Spine. 2020:1-18.
15. Khan I, Parker SL, Bow H, Sivaganesan A, Pennings JS, Stephens Ii BF, et al. Clinical and Cost-Effectiveness of Lumbar Interbody Fusion Using Tritanium Posterolateral Cage (vs. Propensity-Matched Cohort of PEEK Cage). Spine Surg Relat Res. 2022;6:671-80.
16. Luo J, Cao K, Yu T, Li L, Huang S, Gong M, et al. Comparison of Posterior Lumbar Interbody Fusion Versus Posterolateral Fusion for the Treatment of Isthmic Spondylolisthesis. Clin Spine Surg. 2017;30:E915-22.

17. Abdu WA, Sacks OA, Tosteson ANA, Zhao W, Tosteson TD, Morgan TS, et al. Long-Term Results of Surgery Compared With Nonoperative Treatment for Lumbar Degenerative Spondylolisthesis in the Spine Patient Outcomes Research Trial (SPORT). Spine (Phila Pa 1976). 2018;43:1619-30.
18. Nayak NR, Stephen JH, Piazza MA, Obayemi AA, Stein SC, Malhotra NR. Quality of Life in Patients Undergoing Spine Surgery: Systematic Review and Meta-Analysis. Global Spine J. 2019;9:67-76.
19. Riksaasen AS, Kaur S, Solberg TK, Austevoll I, Brox JI, Dolatowski FC, et al. Impact of the number of previous lumbar operations on patient-reported outcomes after surgery for lumbar spinal stenosis or lumbar disc herniation. Bone Joint J. 2023;105-B:422-30.