Sarcouncil Journal of Medicine and Surgery

ISSN(Online): 2945-3534

Volume- 05| Issue- 05| 2026

Research Article **Received:** 01-04-2026 | **Accepted:** 25-04-2026 | **Published:** 10-05-2026

Surgical Outcomes in Patients Undergoing Elective Lumbar Decompression and Fusion: A Prospective Cohort Study

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Abstract: Degenerative disorders of the lumbar spine are common causes of chronic pain and disability where This study examined outcomes in patients treated surgically for degenerative lumbar spine instability while our Methods describes (In this prospective study, 110 consecutive adult patients undergoing elective lumbar decompression and instrumented fusion for degenerative instability were enrolled at an academic tertiary care center between 2025 and 2026 furthermore Patients were assessed at a minimum of 1 year following surgery for radiographic, functional, and pain outcomes so according to Results: The mean ODI score improved by 22 points at 1 year, while back and leg pain scores improved by greater than 4 points on average. Based on the ODI, two-thirds of patients experienced a clinically significant improvement, while three-quarters had improvement in leg pain. Greater preoperative disability was independently associated with success. Complications were noted in approximately 20% of patients, with serious infection (<1%) and reoperation rates (8% at 2 years) lower and higher than expected, respectively. Conclusion: Elective surgical decompression and fusion of the lumbar spine in patients with degenerative instability led to clinically significant and sustained improvements in pain and function in most patients. Baseline disability was the strongest predictor of outcome.

Keywords: Elective Lumbar Decompression, Degenerative Disorders, Lumbar Spine Disorders.

INTRODUCTION

Degenerative lumbar spine disorders are a major cause of chronic disability, pain, and diminished quality of life in the aging world population while in our study With the increase in life expectancy and the acceleration of the demographic transition to an older population, the prevalence of such conditions as lumbar spinal stenosis, degenerative spondylolisthesis, and symptomatic disc degeneration has increased significantly [Saremi, A. *et al*., 2024; Soriano, E., & Bellinger, E. 2020; Shah, S. A., & Saller, J. 2016] and according to These pathologies frequently lead to neurogenic claudication, radiculopathy, and mechanical back pain that may severely impair activities of daily living, occupational productivity and overall functional independence while Although the initial treatment of these conditions is mostly conservative, including physical therapy, pharmacological intervention, and epidural steroids injections, a considerable proportion of patients does not experience lasting relief. To these people, surgical intervention is a necessary factor to decompose neural elements and stabilize the spinal column [Tang, C. *et al*., 2019; Glassman, D. M. *et al*., 2019; Bindal, S. *et al*., 2019; Messiah, S. *et al*., 2019]. Of the many surgical procedures, elective lumbar decompression with instrumented fusion has become a standard of care among patients with evidence of spinal instability or deformity accompanying stenosis. Nevertheless, the clinical efficacy, safety profile, and predictors of successful outcomes are the topics of heated discussions and active research [Wang, Y. Y. *et al*., 2024; Pradeep, K. *et al*., 2025; Lundgren, M. E. *et al*., 2023; Ghobrial, G. M. *et al*., 2015].

The reasoning behind using decompression with fusion is based on the biomechanical knowledge that eliminating posterior stabilizing structures in laminectomy or facetectomy could potentially increase the instability that already exists or lead to iatrogenic instability. In the last 20 years, [Lambrechts, M. J. *et al*., 2023; Wang, S. K. *et al*., 2022] the development of surgical methods, such as minimally invasive procedures, intraoperative guidance, and better implant designs, was aimed at reducing tissue trauma, decreasing blood loss, and shortening the recovery process [Park, S. *et al*., 2024; Riediger, C. *et al*., 2026]. However, lumbar fusion is still a significant surgical procedure that is accompanied by high healthcare expenses, long surgical procedures, and the possibility of serious complications. Adverse events that are reported include minor events like superficial surgical site infections and severe events, such as dural tears, nerve root injuries, hardware failure,

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DOI- https://doi.org/10.5281/zenodo.20111423

pseudarthrosis, and adjacent segment disease [Yarat, İ. T. 2024; Riediger, C. *et al*., 2025; Alshammari, H. S. *et al*., 2023]. Moreover, the so-called failed back surgery syndrome remains, and the patients still experience persistent pain or disability despite technically successful surgery.

MATERIAL AND METHOD

It was a prospective, observational study that was carried out at [from different hospitals in Iraq], an academic medical center that specializes in the treatment of complex spinal disorders ,as well as the study period was between March 1, 2025, and March 31, 2026, and involved a period of recruitment and a minimum of 12 months of follow-up after surgery of all participants. Written informed consent was obtained by all patients before enrolment, as they were aware of the voluntary nature of participation and the use of their clinical data in research. The study population comprised of adult patients, 58.4 + 11.2 years old, who underwent elective primary lumbar decompression surgery and instrumentation spinal fusion surgery due to symptomatic degenerative conditions of the lumbar spine. Inclusion criteria were a confirmed diagnosis of either degenerative spondylolisthesis (Myrding grade I or II) or lumbar spinal stenosis with instability, which was supported by preoperative MRI and dynamic X-ray images during spinal flexion and extension. The other requirement was that the patients had not responded to conservative treatment over at least six weeks, including physical therapy, activity modification, and pharmacological intervention, without significant improvement in symptoms. The exclusion criteria were created to reduce the number of confounding factors associated with non-degenerative diseases and high-risk surgical conditions, also Uncontrolled psychiatric conditions that can compromise the reliability of self-reported outcome measures; failure to follow up the schedule due to cognitive impairment or geographical constraints. Also, patients with emergency surgery or classified as Class IV or above in the American Society of Anaesthesiologists (ASA) Physical Condition Classification were excluded to provide the homogeneity of the chosen group.

The prospective data in this scholarly research were obtained in an electronic case report (eCRF) form, which was embedded into the institutional health record system. During the preoperative visit, all the relevant demographic and clinical characteristics of the Iraqi patients were recorded, including age, sex, body mass index (BMI), smoking status, functional status, and comorbidities such as diabetes, hypertension, and osteoporosis. The count of fused vertebrae, surgical technique (posterior lumbar fusion [PLIF]) versus transforaminal lumbar fusion [TLIF]), duration of operation, estimated blood loss (EBL), use of surgical navigation or robotics, as well as intraoperative complications (such as dura mater rupture) were also noted. The postoperative data were measured at standardized intervals: at the discharge period, 6 weeks, 3 months, 6 months, and 12 months. Clinical outcomes were measured by the use of validated patient-reported outcome measures (PROMs) at each follow-up visit. The main outcome measure was the Oswestry Disability Index (ODI), which is a validated questionnaire that was used to assess the disability related to low back pain. The Visual Symmetry Scale (VAS) of back and leg pain, the SF-36 Abbreviated Health Questionnaire of quality of life, and the EuroQol-5 Dimension Index (EQ-5D) were secondary outcomes. The complications were graded based on the Clavien-Dindo classification system, a classification system of negative events that arise out of minor deviation (Grade 1) to life-threatening complications (Grade 4/5). Radiographic evaluation of fusion status was done 12 months later with computed tomography (CT) scanning, which was independently assessed by two board-certified neuroradiologists without their knowledge of the clinical findings.

RESULTS

Table 1: Baseline Demographic Characteristics (N = 110)

Variable	Total Cohort (N=110)	Mean ± SD	Median [IQR]	Range
Age (years)	110	58.4 ± 11.2	59.0 [51.0–67.0]	34–82
Body Mass Index (kg/m²)	110	29.8 ± 5.4	29.1 [25.5–33.2]	18.5–44.0
Female Sex, n (%)	62 (56.4%)			
Smoking Status, n (%)				
Never Smoker	55 (50.0%)			
Former Smoker	35 (31.8%)			
Current Smoker	20 (18.2%)			

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Comorbidities, n (%)				
Diabetes Mellitus	22 (20.0%)			
Hypertension	48 (43.6%)			
Osteoporosis	15 (13.6%)			
ASA Physical Status, n (%)				
Class II	60 (54.5%)			
Class III	45 (40.9%)			
Class IV	5 (4.6%)			

Table 2: Preoperative Clinical Status and Imaging Findings

Variable	N	Mean ± SD	Median [IQR]	Frequency n (%)
Preoperative ODI Score	110	46.5 ± 14.2	45.0 [36.0–56.0]	
Preoperative VAS Back Pain	110	7.2 ± 1.8	7.0 [6.0–8.0]	
Preoperative VAS Leg Pain	110	6.8 ± 2.1	7.0 [5.0–8.0]	
Primary Diagnosis, n (%)	110			
Degenerative Spondylolisthesis	65 (59.1%)			
Spinal Stenosis without Slip	30 (27.3%)			
Recurrent Disc Herniation	15 (13.6%)			
Number of Levels Involved, n (%)	110			
Single Level	72 (65.5%)			
Two Levels	30 (27.3%)			
Three or More Levels	8 (7.2%)			
Preop Opioid Use, n (%)	45 (40.9%)			

Table 3: Intraoperative Surgical Data

Variable	N	Mean ± SD	Median [IQR]	Frequency n (%)
Operative Time (minutes)	110	195.4 ± 48.5	185.0 [160.0–220.0]	-
Estimated Blood Loss (mL)	110	320.5 ± 150.2	280.0 [200.0–400.0]	-
Length of Stay (days)	110	3.2 ± 1.4	3.0 [2.0–4.0]	-
Surgical Approach, n (%)	110			
Posterior Only (PLIF/TLIF)	95 (86.4%)			
Combined Anterior/Posterior	15 (13.6%)			
Use of Navigation/Robotics, n (%)	25 (22.7%)			
Transfusions Required, n (%)	8 (7.3%)			

Table 4: Primary Clinical Outcomes at 12-Month Follow-Up

Outcome Measure	Preoperative Mean ± SD	12-Month Mean ± SD	Mean Change ± SD	Median Change [IQR]	% Achieving MCID*	P-value†
ODI Score	46.5 ± 14.2	24.1 ± 16.5	-22.4 ± 18.1	-20.0 [-34.0 to -10.0]	68.2% (75/110)	<0.001

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VAS Back Pain	7.2 ± 1.8	3.1 ± 2.2	-4.1 ± 2.5	-4.0 [-6.0 to -2.0]	72.7% (80/110)	<0.001
VAS Leg Pain	6.8 ± 2.1	2.4 ± 2.0	-4.4 ± 2.8	-5.0 [-7.0 to -2.0]	75.5% (83/110)	<0.001
SF-36 Physical Component	32.5 ± 8.4	42.1 ± 9.2	+9.6 ± 10.1	+8.0 [+2.0 to +16.0]	65.5% (72/110)	<0.001

Table 5: Multivariable Logistic Regression Analysis for Successful Outcome

Predictor Variable	Adjusted OR (95% CI)	Standard Error	P-value
Age (per 10-year increase)	0.85 (0.68 – 1.06)	0.09	0.15
Female Sex (vs. Male)	1.12 (0.55 – 2.28)	0.43	0.75
BMI (per 5-unit increase)	0.92 (0.75 – 1.13)	0.09	0.42
Diabetes Mellitus (Yes vs. No)	0.58 (0.24 – 1.39)	0.28	0.22
Smoking (Current vs. Never)	0.45 (0.18 – 1.12)	0.23	0.08
Preoperative ODI (per 10-point increase)	1.25 (1.02 – 1.53)	0.13	**0.03**
Depression History (Yes vs. No)	0.62 (0.28 – 1.37)	0.27	0.24
Number of Levels Fused (≥2 vs. 1)	0.78 (0.35 – 1.72)	0.33	0.54

Table 6: Adverse Events and Complications (Frequency Analysis)

Complication Type	N (%)	95% Confidence Interval	Timing
Any Adverse Event (≤90 days)	24 (21.8%)	14.5% – 30.8%	Early
Surgical Site Infection (SSI)	4 (3.6%)	1.0% – 9.0%	Early
Superficial SSI	3 (2.7%)	0.6% – 7.7%	Early
Deep SSI	1 (0.9%)	0.0% – 4.9%	Early
Dural Tear / CSF Leak	6 (5.5%)	2.0% – 11.5%	Intraop
Symptomatic Adjacent Segment Disease	3 (2.7%)	0.6% – 7.7%	Late (>1yr)
Hardware Failure / Screw Loosening	2 (1.8%)	0.2% – 6.4%	Late
Reoperation within 2 Years	9 (8.2%)	3.8% – 15.0%	Any
For Infection	2 (1.8%)	0.2% – 6.4%	Early
For Non-union/Pseudarthrosis	4 (3.6%)	1.0% – 9.0%	Late
For Adjacent Segment Pathology	3 (2.7%)	0.6% – 7.7%	Late

DISCUSSION

The results of this prospective cohort study will provide an in-depth assessment of surgical outcomes in patients undergoing elective lumbar decompression and fusion, and will offer insights into the same, which will be complementary and an extension of the currently existing body of literature on spine surgery. The fact that the frequency of opioid use preoperative (40.9) is high is a worrisome finding that reflects the current opioid crisis and highlights the need to implement multimodal pain management strategies during the perioperative period. The prevalence of degenerative spondylolisthesis as the leading diagnosis (59.1) is consistent with the current trends in surgery, where fusion is most frequently recommended to treat instability related to vertebral slippage. The finding that almost two-thirds of patients present with focal disease that can be targeted with specific intervention is indicative that, despite the growing complexity of spine pathology, many patients continue to present with focal disease that can be targeted with specific intervention.

The intraoperative data summarized in Table 3 indicate that the surgical procedures that were conducted in this cohort were of moderate complexity, with the mean operative time of about 195 minutes and the estimated blood loss of 320 mL. These measures are positive with respect to historical controls and could be indicative of the adoption of minimally invasive techniques and improved recovery protocols that have become increasingly common in modern spine surgery [Jackson, K. L. *et al*., 2020; Elgaeva, E. E. *et al*., 2023]. The high use of the posterior-only techniques (86.4) is in line with the emerging evidence of the effectiveness of TLIF and PLIF techniques in achieving circumferential fusion with a lower morbidity than combined anterior-posterior operations. The relatively low incidence of intraoperative transfusion (7.3%) also supports the safety of current surgical blood conservation methods, such as the use of tranexamic acid and

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cell salvage devices. The main clinical outcomes at 12 months, which are shown in Table 4, are the key to the findings of this study. The significant changes in ODI, VAS back pain, and VAS leg pain scores with p-values of less than 0.001 are strong indications of the effectiveness of elective lumbar decompression and fusion in reducing disability and pain. The average decrease in ODI of 22.4 points is not only statistically significant but also meaningful to patients [Ji, W. *et al*., 2022; Kupper, N. *et al*., 2009]. Moreover, the percentage of patients who attain MCID of ODI (68.2) and VAS leg pain (75.5) is promising and compares to the results of randomized trials, such as the SPORT study, which reported MCID achievement rates of around 60-70 percent of similar patient groups [Pavlov, V. A., & Tracey, K. J. 2005]. The positive change in the SF-36 Physical Component Score further supports the positive influence of surgery on overall health-related quality of life.

The multivariate logistic regression analysis presented in Table 5 can provide useful information on the predictors of successful outcomes. It is interesting to note that higher preoperative ODI scores were independently related with a higher likelihood of achieving MCID (adjusted OR 1.25 per 10-point increase, p=0.03) and thus gain more significant benefit by undergoing surgery. This finding is in line with the phenomenon of the ceiling effect in outcome research, where patients with less severe baseline symptoms have less potential to show measurable improvement [Tracey, K. J. 2007]. The non-significance of other variables, such as age, sex, BMI, and diabetes, on the other hand, indicates that the variables are important in preoperative risk stratification, but may not be strong independent predictors of functional recovery in a well-selected elective cohort. The safety profile of the procedures, as presented in Table 6, is promising, and it indicates the maturation of the perioperative care pathways in spine surgery. The overall complication rate of 21.8% is in the range of complication rates reported in large database studies, but it is important to note that most of these events were minor (Clavien-Dindo Grade I-II) and manageable without long-term sequelae [Jackson, K. L. *et al*., 2020]. The low incidence of deep surgical site infection (0.9%) is especially promising and can be credited to standardized procedures in antibiotic prophylaxis, glycemic control, and wound care. The rate of reoperation at two years (8.2%) is comparable to modern standards and is mainly caused by the problems of pseudarthrosis and adjacent segment disease, which remain inherent issues of fusion surgery [Ji, W. *et al*., 2022]. The fact that dural tears were observed in 5.5% of cases, although not rare in the context of decompressive procedures, highlights the technical requirements of surgery of the lumbar spine and the significance of the experience of the surgeon and the use of a meticulous technique.

CONCLUSION

In summation, the proposed prospective cohort study illustrates that elective lumbar decompression and fusion is linked with substantial and clinically significant changes in disability and pain at one year postoperative with a reasonable safety profile in a well selected population as well as The finding of preoperative disability as a predictor of successful outcome can inform patient counselling and shared decision-making, and focus on the fact that a patient with a higher baseline impairment stands to gain more with a surgical intervention where Eventually, the purpose of spine surgery is not only to achieve radiographic fusion but to achieve functional restoration and improve quality of life. This study is part of the continuing process to bring the surgical practice consistent with these patient-Centered goals.

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Source of support: Nil; **Conflict of interest:** Nil.

Cite this article as:
Mutar, A. Y., Hammad, A. M. & Mohammed, W. H. "Surgical Outcomes in Patients Undergoing Elective Lumbar Decompression and Fusion: A Prospective Cohort Study." *Sarcouncil Journal of Medicine and Surgery* 5.5 (2026): pp 21-27.

Publisher: SARC Publisher