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ORIGINAL ARTICLE
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PSYCHOLOGICAL BURDENS IN LUMBAR SPINAL STENOSIS: THE UNDERRATED INFLUENCE OF PRE-OPERATIVE DEPRESSION AND ANXIETY ON SURGICAL OUTCOMES AND QUALITY OF LIFE

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ABSTRACT

Objective: This study investigated the impact of pre-operative anxiety and depression on health-related quality of life (H-RQOL) after surgery for lumbar spinal stenosis (LSS) surgery.

Materials and Methods: We reviewed 152 consecutive patients with single-level LSS who underwent laminectomy or laminectomy with fusion. With the use of pre-operative Hospital Anxiety and Depression Scale to evaluate H-RQOL, patients were divided into (A+)/(A-) or (D+)/(D-) according to the positivity of anxiety or depression. H-RQOL was assessed pre-operatively and post-operatively using Oswestry Low Back Pain Disability Questionnaire (ODI) and visual analogue scale (VAS).

Results: (A+) and (D+) had higher pre-operative ODI scores and pre-operative VAS scores (D+). Had higher pre-operative ODI and VAS scores than (D-). (A+) Had higher pre-operative ODI and VAS scores than (A-). Post-operative ODI and VAS scores were higher in (D+). There was no significant difference between the post-operative ODI and VAS scores in (A+).

Conclusion: Pre-operative depression, independent of anxiety, reduces the effectiveness of LSS surgery and negatively impacts post-operative quality of life.

Keywords: Health-related quality of life, Hospital Anxiety and Depression Scale, lumbar spinal stenosis

INTRODUCTION

Lumbar spinal stenosis (LSS) is a degenerative condition of the lumbar spine characterized by motor and sensory impairments, often accompanied by gait disturbances and neuropathic pain due to spinal cord compression. Affecting over 103 million adults worldwide, LSS is a leading cause of severe pain, mobility limitations, and the most common indication for spinal surgery in adults[1]. The condition typically manifests as pain in the lower back, buttocks, and legs, which worsens with activities such as standing or walking and improves with forward flexion, sitting, or lying down. This pain results from a narrowing of the spinal canal, compressing nerves and blood vessels[2].

The impact of LSS extends beyond physical symptoms, significantly impairing activities of daily living (ADLs) and health-related quality of life (H-RQOL) in a rapidly aging population, where maintaining quality of life is increasingly

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essential[3,4]. Various surgical procedures, including laminotomy, decompression, and minimally invasive approaches, aim to alleviate symptoms and improve H-RQOL. However, the outcomes of these surgeries are influenced by multiple factors, including mental health conditions such as depression and anxiety[5].

Mental health disorders are highly prevalent among individuals with chronic pain[6,7]. Depression, in particular, is associated with lower H-RQOL, reduced ADLs, and increased mortality rates[8,9]. Studies have demonstrated that mental health significantly impacts recovery from spine surgeries, including both lumbar and cervical procedures. Despite these findings, limited research has explored the specific relationship between pre-operative depression and anxiety and their effects on H-RQOL in LSS patients undergoing surgical treatment.

Psychological distress, including anxiety and depression, can often be masked by the physical symptoms of back pain. The Hospital Anxiety and Depression Scale (HADS), developed in 1983, is a validated tool designed to assess emotional well-being by focusing solely on psychological symptoms, excluding physical factors such as fatigue or sleep disturbances. This specificity makes HADS particularly useful in conditions like LSS, where physical symptoms might otherwise confound mental health assessments[10,11].

The reliability of HADS in evaluating mental health among spinal patients has been established in numerous studies[12,13]. While there is a growing body of research examining the psychological effects of lumbar surgery[14-17], gaps remain in understanding how different surgical approaches for LSS influence anxiety and depression. This study aims to address these gaps by evaluating the interaction between mental health and surgical outcomes in LSS patients, thereby contributing to a more comprehensive understanding of the psychological dimensions of surgical care.

MATERIALS AND METHODS

Patient Selection

The study was approved by the İstanbul Medipol University of Non-interventional Clinical Research Ethics Committee (decision number: 413, date: 18.04.2024). All patients provided written informed consent for the procedures performed. We retrospectively analyzed data from 179 patients with a single level LSS who underwent surgery at our institution between March 2017 and March 2023. The diagnosis of LSS was made by expert neurosurgeons using both neurological examination and magnetic resonance imaging studies. Patients were divided into those who underwent only laminectomy and those who underwent fixation-fusion surgery. Exclusion criteria for the study included patients under 18 years of age, those with radiculopathy or myelopathy symptoms resulting from lumbar disc herniation, infection, neoplasm, or rheumatologic diseases, and those who had undergone previous spinal surgery. Patients with multiple levels of LSS were excluded from the study because the option of only laminectomy in patients with multiple levels of LSS was thought to impair stabilization. Out of the 179 patients initially included in the study, 27 were excluded due to age or inability to be reached through communication channels. Finally, the study reviewed 152 patients (Figure 1).

At our institution, surgical strategies for LSS are as follows: 1) Patients with a single level LSS, without >5 mm motion on flexion-extension lateral radiographs and without accompanying listhesis, are operated on only for decompression. Only laminotomy is performed, preserving as much stability as possible without touching the facet joints of the patients. 2) Short level fixation and posterior fusion surgery is performed in single level LSS patients with >5 mm movement on flexion-extension lateral radiographs. 3) Fixation and fusion surgery is performed in symptomatic LSS patients with stenosis at more than one level by decompressing the symptomatic stenosis areas with laminectomy[18].

We retrospectively reviewed the medical records of our patients. We analyzed several factors that could affect their outcomes, including demographic information such as age, gender, body mass index (BMI). Furthermore, we examined details about their condition, such as the duration of their symptoms and their medical history, including diabetes and smoking. We also evaluated their medication use, with a specific focus on anti-depressants and anti-anxiety drugs. Finally, we evaluated the possibility of major post-surgery complications, such as infections at the surgical site (presence of pus draining from the incision or a positive culture test within 30 days of surgery), the need for a second surgery due to epidural hematoma (post-operative 7 days), and any significant neurological deficits (>2 grades of muscle weakness in post-operative one month).

Evaluation of Pre-operative Depression and Anxiety

HADS stands for HADS. It's a questionnaire used to evaluate a patient's emotional state in the week leading up to surgery.

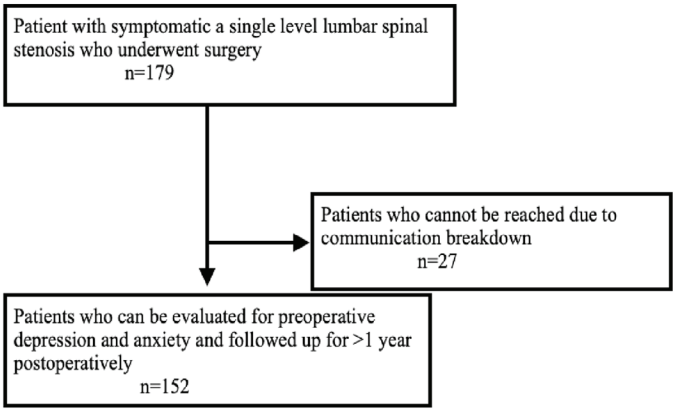


Figure 1. Flowchart of the study population and the patients who completed the outcome measure

The HADS has 14 questions, split into two sections: 7 for depression (D) and 7 for anxiety (A). Each question is scored from 0 (no impairment) to 3 (severe impairment). Higher scores indicate a greater likelihood of depression or anxiety. A score of 0 reflects no signs of depression or anxiety, while a maximum score of 21 indicates severe symptoms. Scores of 8 or higher in either subscale identify individuals as likely having depression or anxiety. These are signified as (D+) for depression and (A+) for anxiety. Scores below 8 [(D-) or (A-)] suggest no depression or anxiety[12].

Clinical Outcome Measures

Patients' H-RQOL was evaluated pre-operatively (within 7 days before surgery) and post-operatively (at least 1 year after surgery) using the Oswestry Low Back Pain Disability Questionnaire (ODI)[19] and the visual analogue scale (VAS) [20]. Post-operative clinical outcomes were assessed using questionnaires administered during the most recent follow-up visit.

Statistical Analysis

To analyze the data and identify any important relationships between the variables, researchers employed statistical tests. For continuous data, such as age or pain scores, the Mann-Whitney U test was used to compare the groups. Categorical data, like presence or absence of a certain condition, was analyzed using the chi-square test. However, this test relies on a minimum number of participants in each category. When this wasn't the case, Fisher's exact test provided a more reliable alternative. Additionally, a One-Way analysis of variance was conducted for subgroup analysis to compare means across multiple groups. All statistical analyses were performed using IBM SPSS Statistics version 23. A finding was considered statistically significant if the probability of it occurring by random chance was less than 5% (p-value <0.05). This threshold helps ensure the observed differences are unlikely due to chance and reflect a true relationship between the variables.

RESULTS

A total of 152 patients were included in this study (Table 1). The patients' ages ranged from 50 to 82 years, with a mean age of 64.03 years [standard deviation (SD 6.77)]. Males comprised 52% of all patients (n=79), while females accounted for 48% (n=73). The mean follow-up period was 16.93 months (SD 3.70), with a range from 12 to 24 months. Among these patients, 64 (42.1%) underwent decompression only, while 88 (57.9%) underwent both decompression and fixation. Regarding pre-operative clinical scores, the mean ODI was 37.63 (SD 13.11) with a range from 10 to 60. The mean pre-operative VAS score was 5.34 (SD 1.96) with scores ranging from 1 to 10. Post-operative outcomes showed an improvement, with the mean ODI score decreasing to 17.96 (SD 15.28), ranging from 0 to 60. The mean post-operative VAS score also decreased to 2.86 (SD 2.02), with scores ranging from 0 to 10 (Table 1) (Figure 2).

When comparing the (A-) and (A+) groups, no significant difference was found in age (p=0.119) or the mean BMI (p=0.105). However, a significantly lower proportion of females was observed in the (A+) group compared to the (A-) group (p=0.046). Additionally, pre-operative ODI and VAS scores were significantly higher in the (A+) group compared to the (A-) group (p<0.05 for both). There was no statistically significant difference in post-operative ODI scores (p=0.082), and post-operative VAS scores (p=0.064) between the two groups (p=0.064). Other factors such as smoking history, diabetes mellitus prevalence, and the proportion of surgeries involving laminectomy or fusion did not differ significantly between the groups (Table 2). When comparing the (D-) and (D+) groups, no significant differences were found in age (p=0.849), mean BMI (p=0.105), or the follow-up period (p=0.919). However, pre-operative ODI and VAS scores were significantly higher in the (D+) group compared to the (D-) group (p<0.05 for both). Post-operative ODI and VAS scores also remained significantly higher in the (D+) group (p<0.05 for both). Additionally, no significant differences were observed between the groups in terms of smoking history, diabetes mellitus prevalence, or the proportion of surgeries involving laminectomy or fusion (Table 3) (Figure 3).

Clinical Outcomes

The subgroup analysis presented in Table 4 aimed to identify whether depression (D) or anxiety (A) had a more significant impact on the pre-operative and post-operative clinical parameters. The analysis revealed that both anxiety and depression significantly affected pre-operative ODI and VAS scores. Specifically, patients with anxiety [(A+) or depression (D+)] had significantly higher pre-operative ODI and VAS scores

Table 1. Characteristic features of the 152 patients included in the study

Variable	Value [n (%)/M ± SD (min.-max.)]
Sex	
Male	79 (52%)
Female	73 (48%)
Age	64.03±6.77 (50-82)
Follow-up (month)	16.9 ±3.70 (12-24)
Surgery	
Decompression	64 (42.1%)
Decompression+fixation	88 (57.9%)
Pre-operative ODI	37.63±13.11 (10-60)
Pre-operative VAS	5.34±1.96 (1-10)
Post-operative ODI	17.96±15.28 (0-60)
Post-operative VAS	2.86±2.02 (0-10)

ODI: Oswestry Low Back Pain Disability Questionnaire, VAS: Visual analogu scale, SD: Standard deviation, M: Mean, min.-max.: Minimum-maximum, *p<0.05: Statistically significant

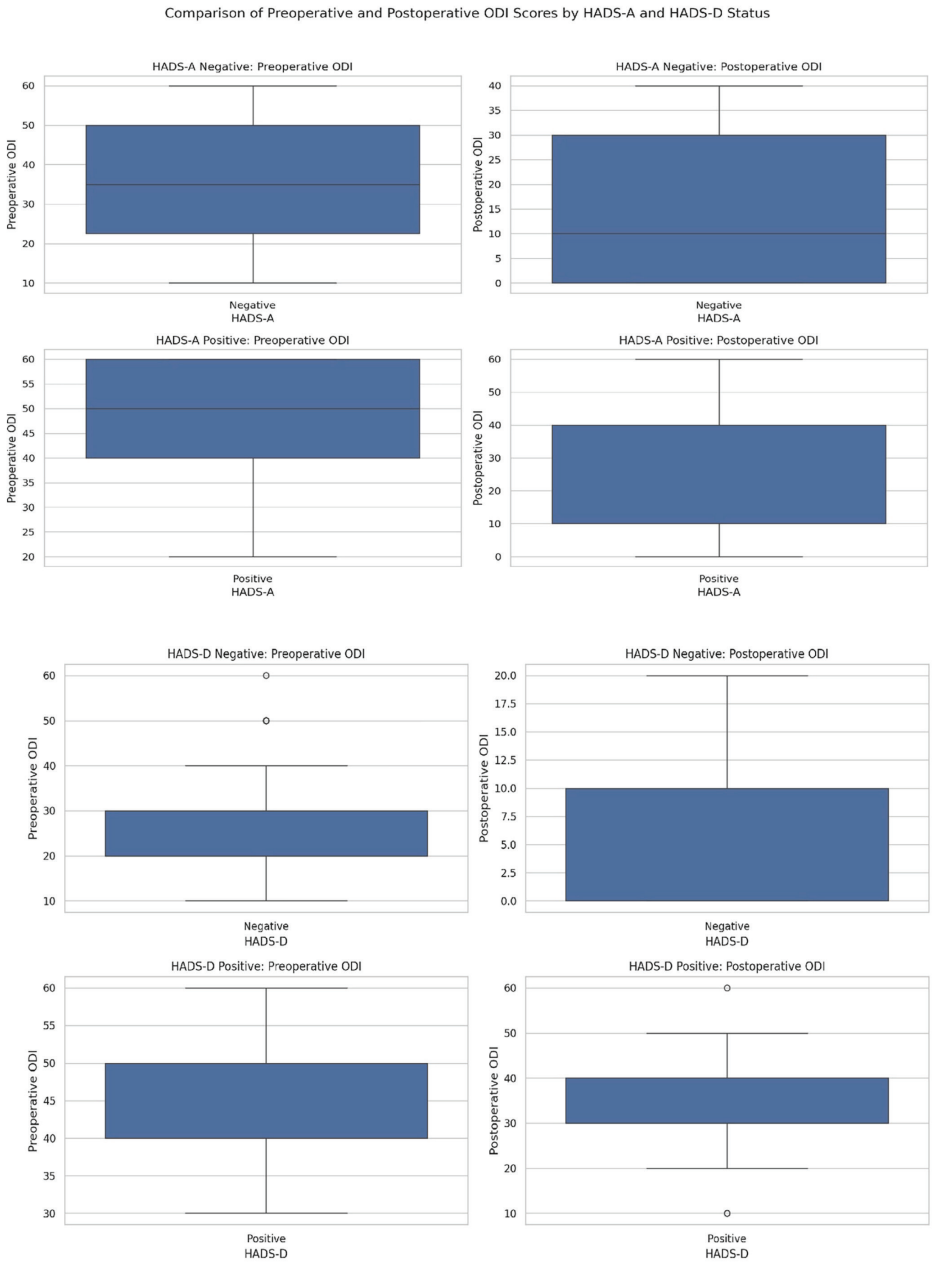


Figure 2. Box plot showing pre-and post-operative ODI results according to A and D
ODI: Oswestry Low Back Pain Disability Questionnaire, HADS: Hospital Anxiety and Depression Scale

compared to those without these conditions [(A-)/(D-)] ($p<0.05$ for all comparisons). However, when comparing post-operative outcomes, depression (D+) had a more consistent impact, with significantly higher post-operative ODI and VAS scores observed in the (D+) group, regardless of anxiety status ($p<0.05$ for most comparisons). In contrast, anxiety (A+) alone did not consistently result in significantly different post-operative scores unless accompanied by depression (Table 4). Patients with neither anxiety nor depression [(A-)/(D-)] had significantly lower pre-operative ODI scores compared to all other groups ($p<0.05$).

Those with anxiety but no depression [(A+)/(D-)] had significantly higher pre-operative ODI scores compared to the (A-)/(D-) group ($p<0.05$). The comparison between patients with depression but no anxiety [(A-)/(D+)] and those with both anxiety and depression [(A+)/(D+)] showed no statistically significant difference ($p=0.142$). The (A-)/(D-) group had significantly lower pre-operative VAS scores compared to all other groups ($p<0.05$). There was no significant difference between the (A+)/(D-) group and the (A-)/(D+) group ($p=0.790$). The (A+)/(D+) group had significantly higher pre-operative VAS scores compared to the (A-)/(D-) group ($p<0.05$). The post-operative ODI scores showed that patients without anxiety or depression [(A-)/(D-)] had significantly lower scores compared to the (A-)/(D+) and (A+)/(D+) groups ($p<0.05$). There was no significant difference

Table 2. Comparison of A (-) and A (+) patients

Variable	(A-)	(A +)	p-value
No of patients (%)	120 (78.9)	32 (21.1)	
Female, n (%)	63 (41.4)	10 (6.6)	0.046
Male, n (%)	57 (37.5)	22 (14.5)	
Age [M±SD (min.-max.)]	64.5±6.83 (50-82)	62.4±6.35 (53-73)	0.119
Follow-up (month) [M±SD (min.-max.)]	16.9±3.71 (12-24)	16.9±3.71 (12-24)	0.919
Pre-operative ODI (M±SD)	35.0±12.04	46.7±12.73	<0.05*
Pre-operative VAS (M±SD)	5.14±1.92	6.03±1.95	<0.05*
Post-operative ODI (M±SD)	16.53±13.67	22.94±19.31	0.082
Post-operative VAS (M±SD)	2.55±1.65	3.94±2.55	0.064
Mean BMI (kg/m^2) (SD)	23.7 (4.2)	25.8 (4.6)	0.105
Smoking history, %	60	50	0.676
Diabetes mellitus, %	33.3	40.6	0.568
Anti-depressant or anoxialytic use, %	1.6	3.1	0.743
Surgery with laminectomy, %	36.6	15.6	0.124
Surgery with fusion, %	63.3	84.3	0.238

*Comparative analysis was conducted using Fisher's exact test or Student's t-test. ODI: Oswestry Low Back Pain Disability Questionnaire, VAS: Visual Analogue Scale, SD: Standard deviation, BMI: Body mass index, M: Mean, min.-max.: Minimum-maximum, *p<0.05: Statistically significant, A: Hospital Anxiety and Depression Scale for Anxiety

Table 3. Comparison of D (-) and D (+) patients

Variable	(D-)	(D+)	p-value
No of patients (%)	86 (56.6)	66 (43.4)	
Female, n (%)	49 (32.2)	24 (15.8)	0.097
Male, n (%)	37 (24.3)	42 (27.6)	
Age [M±SD (min.-max.)]	64.1±6.81 (50-82)	62.6±6.50 (51-80)	0.024
Follow-up (month) [M±SD (min.-max.)]	16.9±3.59 (12-24)	17.0±3.87 (12-24)	0.849
Pre-operative ODI (M±SD)	29.7±11.02	47.61±7.61	<0.05*
Pre-operative VAS (M±SD)	4.92±1.86	5.87±1.96	<0.05*
Post-operative ODI (M±SD)	6.2±5.97	32.84±9.34	<0.05*
Post-operative VAS (M±SD)	1.81±1.34	4.1±1.83	<0.05*
Mean BMI (kg/m^2) (SD)	24.8	25.4	0.359
Smoking history, %	65.1	66.6	0.765
Diabetes mellitus, %	37.2	33.3	0.864
Anti-depressant or anoxialytic use, %	3.4	3.0	0.876
Surgery with laminectomy, %	34.8	30.3	0.852
Surgery with fusion, %	65.1	69.9	0.736

*Comparative analysis was conducted using Fisher's exact test or Student' t-test. ODI: Oswestry Low Back Pain Disability Questionnaire, VAS: Visual Analogue Scale, SD: Standard deviation, BMI: Body mass index, M: Mean, min.-max.: Minimum-maximum, *p<0.05: Statistically significant, D: Hospital Anxiety and Depression Scale for Depression

in post-operative ODI scores between the (A-)/(D-) and (A+)/(D-) groups (p=0.441). The post-operative VAS scores were significantly lower in the (A-)/(D-) group compared to both the (A-)/(D+) and (A+)/(D+) groups (p<0.05). No significant difference was found between the (A+)/(D-) and (A-)/(D-) groups (p=0.764) (Figure 4).

DISCUSSION

This research aimed to explore the influence of pre-operative depression and anxiety on post-operative quality of life in individuals undergoing surgery for lumbar stenosis. The findings reveal that patients with pre-operative depression reported poorer quality of life and greater levels of pain

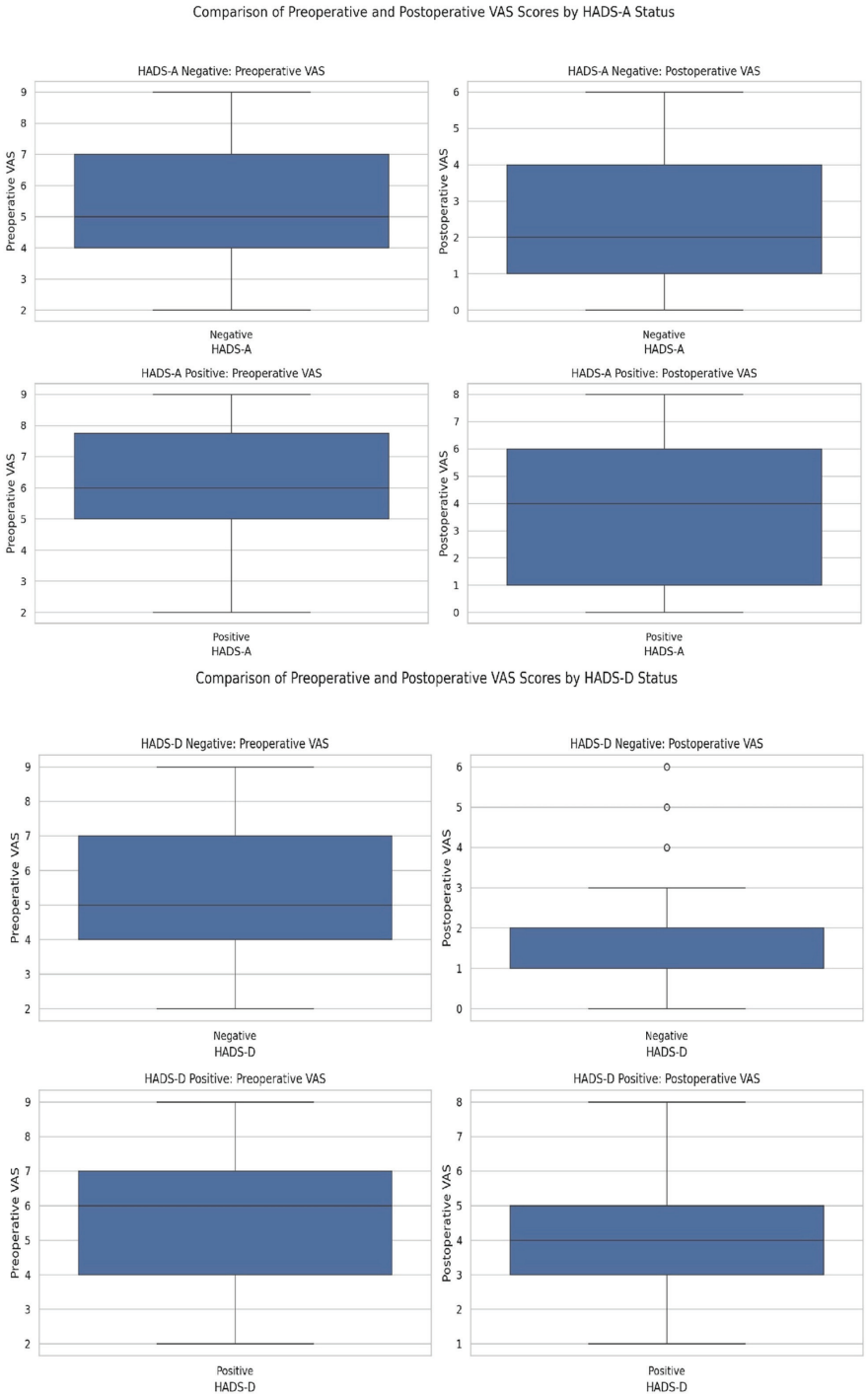


Figure 3. Box plot showing pre-and post-operative VAS results according to A and D
VAS: Visual analogue scale, HADS: The Hospital Anxiety and Depression Scale

before surgery compared to those without depression. When evaluating quality of life using different assessment tools, it was observed that ODI scores were notably higher in patients with depression, while VAS scores-used to gauge pain-were significantly lower in patients without depression.

Regarding anxiety, the data showed that ODI scores were considerably elevated in patients experiencing pre-operative anxiety, whereas their VAS scores were comparable to those of patients without anxiety. This observation indicates that anxiety impacts perceived functional disability (measured by ODI) more than perceived pain intensity (measured by VAS). The disparity in scoring outcomes may stem from the ODI's focus on daily functional activities, as opposed to the VAS's emphasis on pain levels. These results suggest that chronic lumbar pain might be more strongly associated with depression than with anxiety.

Table 4. Changes of subgroups in pre-operative and post-operative parameters

Pre-operative ODI	**(A+)/(D-)**	**(A-)/(D+)**	**(A+)/(D+)**
A (-) D (-)	<0.05*	<0.05*	<0.05*
A (+) D (-)		0.134	<0.05*
A (-) D (+)			0.142
Pre-operative VAS	(A+)/(D-)	(A-)/(D+)	(A+)/(D+)
A (-) D (-)	<0.05*	<0.05*	<0.05*
A (+) D (-)		0.790	<0.05*
A (-) D (+)			0.614
Post-operative ODI	(A+)/(D-)	(A-)/(D+)	(A+)/(D+)
A (-) D (-)	0.441	<0.05*	<0.05*
A (+) D (-)		<0.05*	<0.05*
A (-) D (+)			0.765
Post-operative VAS	(A+)/(D-)	(A-)/(D+)	(A+)/(D+)
A (-) D (-)	0.764	<0.05*	<0.05*
A (+) D (-)		<0.05*	<0.05*
A (-) D (+)			0.735

*Comparative analysis was conducted using Fisher's exact test or Student's t-test or ANOVA. ODI: Oswestry Low Back Pain Disability Questionnaire, VAS: Visual Analogue Scale, SD: Standart deviation, M: Mean, min.-max.: Minimum-maximum, *p<0.05: Statistically significant, A: Hospital Anxiety and Depression Scale for Anxiety, D: Hospital Anxiety and Depression Scale for Depression, ANOVA: Analysis of variance

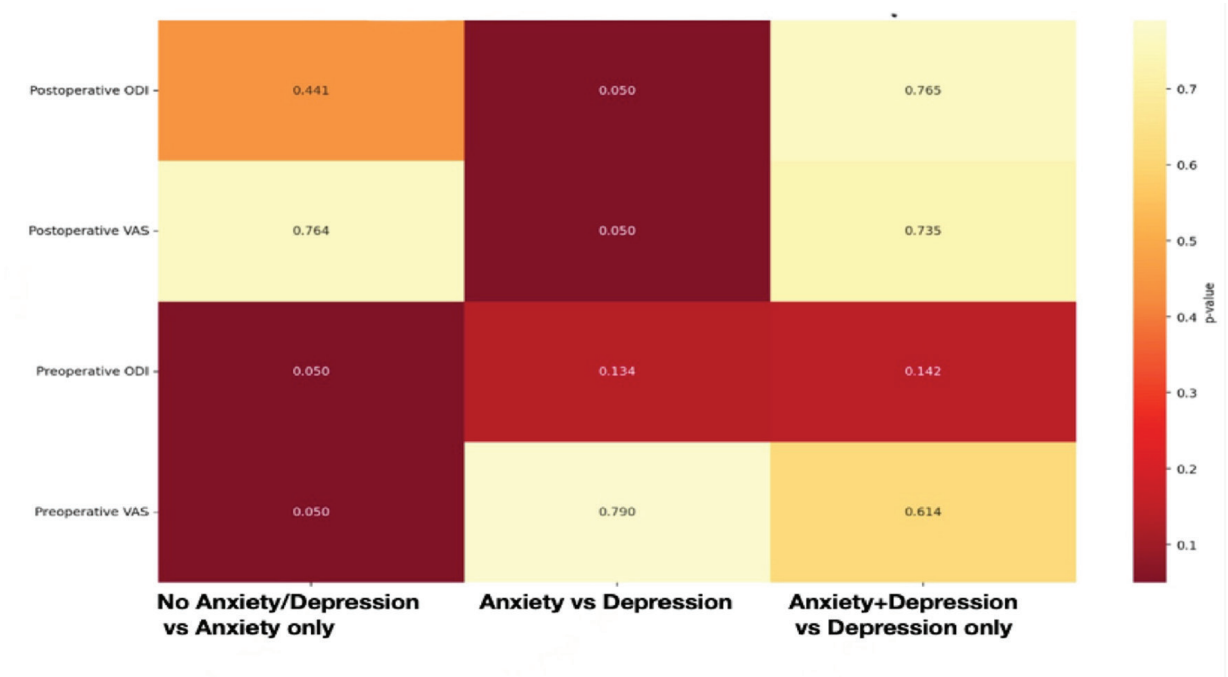


Figure 4. Heatmap of pre-operative and post-operative outcomes by anxiety and depression groups
ODI: Oswestry Low Back Pain Disability Questionnaire, VAS: Visual Analogue Scale

Significant improvements in both ODI and VAS scores were recorded across all patients, regardless of the surgical technique performed or the presence of pre-operative anxiety or depression. These outcomes suggest that the surgical interventions effectively reduced perceived disability and pain, affirming the appropriateness of the surgical indications.

However, long-term post-operative follow-ups demonstrated that patients with pre-operative anxiety and depression continued to exhibit significantly lower quality of life compared to those without these psychological conditions. This highlights the enduring impact of mental health on recovery and overall well-being. It is worth noting that this analysis relies exclusively on objective measurements and does not account for subjective patient feedback.

Despite the considerable improvement in H-RQOL following surgery, patients with depression or anxiety still showed a significant reduction in quality of life compared to those without these conditions. While the surgery itself was beneficial, it did not achieve optimal quality of life outcomes in these individuals, indicating that psychological distress substantially hampers recovery. It is evident that lumbar pain alone cannot fully explain these findings. Our analysis underscores the notable role of psychological factors in influencing pain perception and quality of life.

Previous studies have suggested that the impact of depression on outcomes in lumbar stenosis surgery ranges from mild to moderate[21]. This study, however, identified a substantial relationship between depression and diminished post-operative quality of life. This aligns with existing literature, underscoring depression as a critical determinant of surgical outcomes. It reinforces the necessity of carefully evaluating the need for surgery, particularly given the variability in methodologies and findings across different studies.

One study identified pre-operative depression as a significant independent predictor of reduced symptom improvement following surgery for lumbar stenosis[22]. Another prospective study revealed that psychosocial challenges, such as depression and anxiety, were associated with poorer outcomes[16,17].

In the present study, depression exhibited a pronounced effect on surgical outcomes, independent of anxiety. This was particularly evident among patients with lumbar stenosis, who already endure substantial pain and functional limitations. Interestingly, while anxiety significantly influenced pre-operative quality of life-reflected in higher ODI and VAS scores in (A+) patients compared to (A-)-its effect diminished post-operatively. This suggests that anxiety symptoms may improve after surgery, reducing their negative impact on post-operative outcomes. Conversely, depression persisted as a significant factor affecting both pre-operative and post-operative ODI and VAS scores, demonstrating its lasting adverse effects on quality of life. Although surgical interventions provided benefits, patients with depression consistently reported poorer outcomes compared to their counterparts without depression, thus impacting overall surgical efficacy.

Study Limitations

This study has several limitations that should be acknowledged to provide a clearer understanding of the findings. First, the retrospective design of the study introduces inherent challenges, such as potential selection bias and the inability to establish causality between variables. Retrospective analyses rely on pre-existing data, which may lack the granularity needed to address specific research questions comprehensively.

Second, while no statistically significant differences in surgical methods were observed between patient groups, other unexamined factors could have influenced the post-operative outcomes. For instance, variables such as the duration and severity of symptoms, the extent of radiographic abnormalities, and comorbid conditions were not included in the analysis. Incorporating these predictive factors could have provided a more nuanced understanding of their influence on surgical results.

Third, the reliance on subjective measures such as the HADS, ODI, and VAS poses a limitation. These tools are influenced by individual patient perceptions and external factors, potentially leading to variability in the data. While HADS is a valuable instrument for assessing mood disorders, using more comprehensive evaluations or conducting a numerical comparison of anxiety and depression severity could have offered deeper insights into how these psychological conditions impact surgical outcomes.

Additionally, the study's cohort size and follow-up duration may limit the generalizability of the findings. A larger sample size and extended follow-up periods would enable more robust statistical analyses and help identify longer-term trends in surgical and psychological outcomes.

Lastly, the study did not address the potential interplay between physical and psychological factors in influencing recovery. For example, how radiographic findings correlate with mood disorders or how symptom severity might amplify psychological distress remains unexplored. Addressing these gaps in future research could significantly enhance the understanding of the multifaceted nature of recovery in LSS patients.

In conclusion, these limitations should be carefully considered when interpreting the results of this study. Future investigations should aim to include larger patient cohorts, longer follow-up durations, and additional predictive factors such as symptom severity, duration, and radiographic characteristics to provide a more comprehensive understanding of the variables influencing surgical outcomes in LSS.

CONCLUSION

This study underscores the significant impact of pre-operative depression and anxiety on post-operative outcomes in patients with lumbar stenosis, highlighting the need for comprehensive psychological assessment and management in surgical candidates. Additionally, pre-operative depression, independent of anxiety, significantly reduces the effectiveness of LSS surgery and negatively impacts post-operative quality of life in patients.

Ethics

Ethics Committee Approval: The study was approved by the İstanbul Medipol University of Non-interventional Clinical Research Ethics Committee (decision number: 413, date: 18.04.2024).

Informed Consent: All patients provided written informed consent.

Footnotes

Authorship Contributions

Surgical and Medical Practices: E.U., H.Ş.Ç., A.Y.Y., Concept: S.İ.A., H.C.Ç., Design: H.Ş.Ç., S.İ.A., M.V.A., Data Collection or

Processing: H.C.Ç., A.H.Y., Analysis or Interpretation: E.U., A.Y.Y., Literature Search: H.C.Ç., A.H.Y., Writing: E.U., M.V.A.

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

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