Pamukkale Medical Journal
doi:https://dx.doi.org/10.31362/patd.1474502

Relationship of anxiety-related symptoms with pain, disability and postoperative period after degenerative lumbar spinal stenosis surgery

Dejeneratif lomber spinal stenoz cerrahisi sonrası anksiyete ilişkili semptomlar ile ağrı, engellilik ve postoperatif süre arasındaki ilişki

Göktuğ Ülkü, Muhammed Erkan Emrahoğlu, Elif Figen Emrahoğlu, Habibullah Dolgun, Erhan Türkoğlu

Posted date:27.04.2024 Acceptance date:26.10.2024

Abstract

Purpose: This study investigates the anxiety symptom levels of patients who underwent surgery due to degenerative lumbar spinal stenosis (DLSS), and the relationship between anxiety symptoms and postoperative pain, disability, and time elapsed after surgery was investigated.

Materials and methods: The research study group comprises 71 patients, and the control group comprises 65 healthy individuals. In the study, the pain, disability, and anxiety symptom levels of the patients were evaluated. Postoperative State Anxiety Inventory (SAI) and Trait Anxiety Inventory (TAI) scores of DLSS patients and healthy individuals were compared. The variability of the anxiety scores of the individuals in the study group was analyzed in separate groups divided according to gender, postoperative period, pain, and disability scores. Patients were divided into two groups: painful (VAS >6) and pain-free (VAS <7), according to Visual Analogue Scale (VAS) scores representing pain levels.

Results: The results show that the patient's anxiety symptom levels are higher than the healthy controls and that anxiety scores increase even more in patients with high pain and disability scores. Higher pain and disability scores were associated with higher SAI scores. Moreover, it was found that both the painful early postoperative and painful late postoperative groups had higher SAI scores compared to the pain-free early postoperative and pain-free late postoperative groups.

Conclusion: These findings emphasize the importance of considering pain, physical disabilities, and anxiety symptoms together in supporting the postoperative recovery process. It can be said that holistic approaches focusing on pain, physical disabilities and anxiety can positively affect recovery. More extensive and prospective studies are needed to elucidate the causal relationship between these concepts.

Keywords: Anxiety, disability, pain, spinal stenosis, surgery.

Ulku G, Emrahoglu ME, Emrahoglu EF, Dolgun H, Turkoglu E. Relationship of anxiety-related symptoms with pain, disability and postoperative period after degenerative lumbar spinal stenosis surgery. Pam Med J 2025;18:73-85.

Öz

Amaç: Bu çalışmada dejeneratif lomber spinal stenoz (DLSS) nedeniyle ameliyat geçiren hastaların anksiyete ilişkili semptom düzeyleri ve bu durumun ameliyat sonrası ağrı, engellilik ve ameliyattan sonra geçen süre ile ilişkisi araştırılmıştır.

Gereç ve yöntem: Araştırma çalışma grubu 71 hastadan, kontrol grubu ise 65 sağlıklı bireyden oluşmaktadır. Çalışmada hastaların ağrı, sakatlık ve anksiyete ilişkili semptom düzeyleri değerlendirilmiştir. DLSS hastalarının ve sağlıklı bireylerin Postoperatif Durumluk Anksiyete Envanteri (DAE) ve Süreklilik Anksiyete Envanteri (SAE) puanları karşılaştırılmıştır. Çalışma grubundaki bireylerin anksiyete puanlarının değişkenliği cinsiyete, ameliyat sonrası geçmiş olan süreye, ağrıya ve sakatlık puanlarına göre ayrı gruplar halinde analiz edilmiştir. Hastalar ağrı düzeylerini temsil eden Görsel Analog Skala (VAS) puanlarına göre ağrılı (VAS >6) ve ağrısız (VAS <7) olmak üzere iki gruba ayrılmıştır.

Bulgular: Sonuçlar hastaların anksiyete semptom düzeylerinin sağlıklı kontrollerden daha yüksek olduğunu ve yüksek ağrı ve sakatlık puanına sahip hastalarda anksiyete puanlarının daha da arttığını göstermektedir.

Göktuğ Ülkü, M.D. Ankara Etlik City Hospital, Department of Neurosurgery, Ankara, Türkiye, e-mail: dr.gulku@gmail.com (https://orcid.org/0000-0003-1430-2977) (Corresponding Author)

Muhammed Erkan Emrahoğlu, M.D. Ankara Etlik City Hospital, Department of Neurosurgery, Ankara, Türkiye, e-mail: erkanemrahoglu@hotmail.com (https://orcid.org/0000-0002-0939-3117)

Elif Figen Emrahoğlu, M.D. Ankara Etlik City Hospital, Department of Psychiatry, Ankara, Türkiye, e-mail: eliffigentapsiz@gmail.com (https://orcid.org/0000-0002-1870-3906)

Habibullah Dolgun, Assoc. Prof., Ankara Etlik City Hospital, Department of Neurosurgery, Ankara, Türkiye, e-mail: cshdolgun@yahoo.com (https://orcid.org/0000-0002-1513-2044)

Erhan Türkoğlu, Prof. Ankara Etlik City Hospital, Department of Neurosurgery, Ankara, Türkiye, e-mail: drmet122@yahoo.com (https://orcid.org/0000-0001-7044-617X)

Daha yüksek ağrı ve sakatlık puanları daha yüksek DAE puanlarıyla ilişkilendirildi. Dahası hem ağrılı erken postoperatif hem de ağrılı geç postoperatif gruplarının ağrısız erken postoperatif ve ağrısız geç postoperatif gruplarına kıyasla daha yüksek DAE puanlarına sahip olduğu bulundu.
Sonuç: Bu bulgular, postoperatif iyileşme sürecini desteklemede ağrı, fiziksel sakatlıklar ve anksiyete semptomlarının birlikte ele alınmasının önemini vurgulamaktadır. Ağrıya, fiziksel sakatlıklara ve anksiyeteye odaklanan bütünsel yaklaşımların iyileşmeyi olumlu yönde etkileyebileceği söylenebilir. Bu kavramlar arasındaki nedensel ilişkiyi açıklamak için daha kapsamlı ve prospektif çalışmalara ihtiyaç vardır.

Anahtar kelimeler: Anksiyete, engellilik, ağrı, spinal stenoz, ameliyat.

Ülkü G, Emrahoğlu ME, Emrahoğlu EF, Dolgun H, Türkoğlu E. Dejeneratif lomber spinal stenoz cerrahisi sonrası anksiyete ilişkili semptomlar ile ağrı, engellilik ve postoperatif süre arasındaki ilişki. Pam Tıp Derg 2025;18:73-85.

Introduction

Degenerative lumbar spinal stenosis (DLSS) is a chronic pathology that causes axial low back pain and neurological deficits due to the narrowing of the spinal canal and compression of neural structures resulting from spinal degeneration [1]. DLSS is a common indication for spine surgery today, where the aging population and physical workload are increasing [2]. Hughey et al. [3], in their study on the prevalence of spine surgeries, showed that there were 54,000 spine surgeries in 1993, and this number increased dramatically to 350,000 per year in 2007. According to current epidemiological data, there are 103 million people with symptomatic DLSS in the US, and lumbar fusion and decompression surgeries for its treatment are rapidly increasing [4].

Surgical interventions often evoke intense emotional reactions in patients due to their high medical risk, and these emotional reactions have adverse effects on the course of the disease [5]. Studies report that the impact of psychological factors is more remarkable in musculoskeletal system surgeries than in other surgeries [6]. Furthermore, it has been shown that depression and anxiety are the most common psychiatric disorders in patients with musculoskeletal system disorders [7, 8]. Patients suffering from chronic lumbar spine disease are at serious risk for anxiety due to their long-standing severe pain and consequent functional losses. Those candidates for surgical repair are particularly at risk due to the severity of their symptoms. In addition, patients who undergo lumbar spine surgery are exposed to many stressors that trigger anxiety in the postoperative period [9].

Numerous studies investigating preoperative anxiety in patients undergoing lumbar spine surgery and its effects on surgical outcomes have drawn attention [10-19]. However, the concept of postoperative anxiety in surgically treated patients has gained popularity, especially in recent years. Surgery is a stressful experience associated with a variety of psychological and physiological consequences. Therefore, psychiatric conditions such as anxiety can indeed arise from various factors, such as chronic pain syndromes, loss of ability, predisposing personality traits, unmet expectations, and other stress sources. A significant subgroup of surgical patients develops clinically meaningful new-onset anxiety and depression symptoms. However, the incidence, risk factors, and outcomes of new-onset anxiety after spine surgery have not been fully defined [20].

This study is designed to investigate postoperative anxiety in patients undergoing surgery for DLSS and its relationship with postoperative pain and disability levels and the time elapsed since surgery.

Material and methods

Sample: The required sample size for the results to be obtained before the research to have sufficient power was determined by power analysis. Accordingly, it was determined that the required number of people for two-way hypothesis, medium effect size, 95% confidence level (α=0.05), 80% power level (1-β=0.20) should be 47 for each group, a total of 94 people. Power analysis was performed using the Gpower (version 3.1) package program.

The study group of this research consists of 71 patients aged 18 years and over who applied to Etlik City Hospital Brain and Nerve Surgery outpatient clinics in September 2023 and underwent surgery for DLSS in our clinic in the last six months. The control group consists of 65 individuals, similar in age and gender to the study group, who were examined for various reasons in the clinic and were found to be healthy in terms of spine. These people were selected among patients who applied for non-spine reasons, whose neurological examinations were normal, and who were not diagnosed with any disease in their examinations. Additionally, those who had previously been diagnosed with psychiatric illnesses such as depressive disorders, dementia, anxiety disorders, bipolar disorder, schizophrenia, and obsessive-compulsive disorder were excluded from both the study group and the control group. Patients with trauma and malignancy among surgical indications were excluded due to the presence of secondary factors affecting mental health.

In addition, four patients from the study group were excluded because they could not participate in the data collection processes. Two of the four excluded patients were illiterate, and the other two could not comply with the tests due to language differences.

Surgical technique: In the patients included in the study, the surgical procedure was performed by neurosurgery specialists with the necessary competence and experience in spine surgery. After general anesthesia, a midline lumbar incision was applied to the patients, and the paravertebral muscles were subperiosteally dissected. Instrumentation was applied with transpedicular corpus screws under fluoroscopy guidance. Laminectomy, foraminotomy, and discectomy, if necessary, were performed. Bilateral rods and transverse connectors provided stabilization. Autologous bone grafts were placed posterolaterally for fusion purposes. After the surgical drain placement, the layers were sutured in the anatomical plane.

Data collection tools: The State Anxiety Inventory (SAI) and the Trait Anxiety Inventory (TAI) were administered to the individuals in the study and control groups to measure their state and trait anxiety levels. The Visual Analog Scale (VAS) scores were recorded to calculate the postoperative pain levels of patients who underwent lumbar spinal surgery. The Oswestry Disability Index (ODI) scores were also assessed to measure the physical disability levels of the study group.

State and trait anxiety ınventory: It was developed by Spielberger et al. [21] in 1970. Öner and Lecompte conducted the Turkish adaptation and validity-reliability study in the Turkish population. The SAI consists of 20 items that need to be answered as (1) none, (2) a little, (3) quite, and (4) entirely to express the anxiety level of the individual at a specific time and in a specific situation. The TAI consists of 20 items that need to be answered as (1) rarely, (2) sometimes, (3) much of the time, and (4) almost always, to express the general anxiety level of the individual within the scope of personality traits. There are direct and reverse statements in the scales. Direct statements represent negative emotions, while reverse statements represent positive emotions. There are ten reverse statements in the SAI (1., 2., 5., 8., 10., 11., 15., 16., 19., 20. items) and 7 in the TAI (21., 26., 27., 30., 33., 36., and 39. items). The minimum score of both inventories is 20, while the maximum score is 80. Many studies have found this inventory useful in assessing clinical populations' state and trait anxiety symptom levels [22, 23].

Visual analog scale: It is a subjective expression of pain, a Likert-type scale scored between 0 and 10, with 0=no pain, 5=Moderate pain, and 10=the most severe pain experienced or unbearable pain level [24].

Oswestry disability index: The scale is designed to express the levels of disability in daily physical activities due to low back pain and consists of 10 items with six options ranging from "0" to "5". The first item evaluates the pain level, while the others consider the level of performing daily activities (e.g., dressing, bathing, walking...). The total scale score is divided by 50 if the person answers all the questions and multiplied by 100. The result is expressed as a percentage. It ranges from 0% for patients with no disability to 100% for patients with complete disabilities. The values are classified as minimal disability (0-20%), moderate disability (21-40%), severe disability (41-60%), complete disability (61-80%), and bedridden or exaggerated disability (81-100) [25]. Yakut et al. [26] conducted the Turkish adaptation and validity-reliability study in 2004.

Data collection process: The data for the study were obtained from the self-report scales applied to patients who had undergone surgery for DLSS in the last six months and came to the outpatient clinic for control and individuals who applied to the outpatient clinic and were not diagnosed with any pathological condition (similar to the study group in terms of age and gender) between them, who were healthy in terms of mental and spine health. Neurosurgery resident doctors accompanied the individuals during the process of answering the scales. While expressing VAS scores, the study group individuals were asked to consider the pain level they frequently experienced actively during the day.

Analysis of data: In the study, patients were classified as “early postoperative” (those who underwent surgery within the last three months) and “late postoperative” (those who underwent surgery within the previous six months but more than three months ago) in terms of the postoperative period from surgery to evaluation. VAS scores were considered “painful” for patients with scores of “7” and above and “pain-free” for those with scores of “6” and below. Previous studies have shown that a VAS score above 6 points predicts severe pain [27-29]. In our study, we classified patients who described severe pain as “painful.” Thus, a classification was made for the patients in the study group as “painful early postoperative,” “pain-free early postoperative,” “painful late postoperative,” and “pain-free late postoperative.” The ODI values of the patients in the study group were grouped as 1-minimal disability (0-20%), 2-moderate disability (21-40%), 3-severe disability (41-60%), 4-complete disability (61-80%), and 5-bedridden or exaggerated disability (81-100%). Patients with ODI values of 1 and 2 were considered as “no disability,” and those with 3, 4, and 5 were considered “ disability present.”

Firstly, the frequency and percentages of the sociodemographic characteristics of the study and control groups included in the research were calculated and compared. Especially the gender was considered here. Additionally, the frequency and percentages of the study group in terms of postoperative pain and postoperative period, as well as both groups evaluated together were determined. After the normality analysis of the data obtained from the measurement tools, the SAI and TAI scores of the study group and control group were compared to compare the anxiety levels of patients who underwent surgery due to DLSS with normal healthy individuals. Furthermore, the gender difference between SAI and TAI scores within the study group was evaluated.

To examine the relationship between the anxiety levels of patients who underwent lumbar surgery and their postoperative pain levels, the SAI and TAI scores of the group considered painful were compared with the pain-free group. To evaluate the relationship between patients’ anxiety levels and their physical disability status, the anxiety scores of the group considered to have physical disability were compared with the group evaluated as having no disability. Finally, the SAI and TAI scores of the early postoperative group and late postoperative group were compared to test the relationship between the anxiety levels of patients who underwent surgery and the time elapsed after surgery. In addition, patients were divided into four separate groups based on pain and postoperative period as described above, and the anxiety scores of each group were compared with each other.

Statistical analysis

Data analysis was performed using the SPSS (“Statistical Package for the Social Sciences”) (Version 25) package program and Microsoft Office Excel program. An alpha level of 0.05 was considered for statistical significance. Descriptive statistics measures (frequencies and percentages) were used for summarizing the population and sample, normality tests (Komogorov-Smirnov and Shapiro-Wilk) for the distribution of measurements obtained from measurement tools, the Mann-Whitney U test for variables with two groups, and the Kruskal Wallis H test for variables with more than two groups. The Mann-Whitney U test (with Bonferroni correction) was used to determine the source of the significant difference in the variables as a result of the Kruskal-Wallis test.

The measurements obtained from the measurement tools used in the research show a normal distribution for the control group;

however, they do not show a normal distribution for the patient group ($p<0.05$). So, due to the measurements obtained from the measurement tools, which mainly do not show a normal distribution for the patient group, non-parametric methods have been used to test the hypotheses within the scope of the research.

This study was conducted according to the principles stated in the Declaration of Helsinki and approved by the human research ethics committee of Etlik City Hospital (Registration No:AEŞH-EK1-2023-439 / 09.08.2023).

Results

The study group comprises 71 patients who underwent surgery due to DLSS, while the control group comprises 65 healthy individuals. Table 1 summarizes the frequency and percentages of the sociodemographic characteristics of the study and control groups included in the research.

Upon examining Table 1, it has been determined that the patient and control groups are similar regarding gender and age variables. The average age of the study group is 57.7 (±8.1), while the average age of the control group is 56.6 (±6.9). Among the patients who underwent surgery, 64.8% are in the pain-free group, and 35.2% are in the painful group. Additionally, the numbers of patients in the early and late postoperative periods are similar.

The normality test results of the measurement tools are summarized in Table 2. According to the results of the Mann Whitney U test for comparing SAI and TAI scores, the difference between both SAI and TAI scores of the patient and control groups was found to be statistically significant (SAI p=0.000, TAI p=0.000) (Table 3). To determine which group this difference favors, rank averages have been examined, and it has been found that the patient group has higher SAI and TAI scores. When discussing the effect size calculated for the practical significance of this statistically significant difference, it is observed to have a medium effect.

After comparing the anxiety scores of the patient and control groups, the anxiety scores of patients who underwent surgery due to DLSS have been compared in terms of gender, pain, disability, and postoperative period.

Table 1. Frequency and percentages of sociodemographic information of the patient and control groups

Variables	Categories	Patients (n=71)		Controls (n=65)		t/χ^2	p
		f/mean	%/SD	f/mean	%/SD		
Sex	Female	21	29.6	24	36.9	0.83	0.466
	Male	50	70.4	41	63.1		
Age		57.66	12.59	56.57	12.84	0.50	0.617
Postoperative Pain	Pain-free	46	64.8	--	--	--	--
	Painful	25	35.2				
Postoperative Period	Early periods	37	52.1	--	--	--	--
	Late periods	34	47.9				
Pain and Period	Early – Pain-free	23	32.4	--	--	--	--
	Late – Pain-free	23	32.4				
	Early – Painful	14	19.7				
	Late – Painful	11	15.5				

SD: Standart Deviation, t:independent t-test, χ^2 : Chi-square test

Table 2. Results of normality tests of measuring instruments

Measuring tools	Group	K-S Test		S-W Test	
		Statistics	*p*	Statistics	*p*
SAI	Patient	0.218	0.000*	0.853	0.000*
	Control	0.100	0.173	0.977	0.257
TAI	Patient	0.171	0.000*	0.851	0.000*
	Control	0.110	0.048	0.974	0.1

*: $p<0.05$, K-S Test: Kolmogorov-Smirnov test, S-W Test: Shaphiro-Wilk test, SAI: State Anxiety Inventory, TAI: Trait Anxiety Inventory

Table 3. Mann Whitney U test results regarding the comparison of SAI and TAI scores of the patient and control groups

Variables	Group	N	Mean	SD	Z	*p*	*d*
SAI	Patient	71	37.28	12.10	-4.45	0.000*	0.382
	Control	65	28.35	3.06			
TAI	Patient	71	30.73	4.43	-3.58	0.000*	0.307
	Control	65	28.17	3.43			

*: $p<0.05$, SD: Standart Deviation, d: Cohen's effect size, SAI: State Anxiety Inventory, TAI: Trait Anxiety Inventory

Firstly, the anxiety scores of the patient group were compared according to gender, and it was found that SAI and TAI scores in the patient group did not differ (SAI *p*=0.553, TAI *p*=0.371) (Table 4).

The results of the examination of the patient group's anxiety scores based on the postoperative pain status are summarized in Table 5. In the patient group, the SAI scores are statistically significantly higher in the painful group (*p*=0.000). Considering the rank means, it has been determined that this difference has a significant practical effect. On the other hand, it is found that the TAI scores of the patients do not show a statistically significant difference according to the pain status (*p*=0.147). When rank means are examined, it is understood that the TAI scores are higher in the group with pain, but this difference is not significant.

Table 4. Mann Whitney U test results regarding the comparison of SAI and TAI scores of the patient group by gender

Variable	Gender	N	Mean	SD	Z	*p*	*d*
SAI	Male	21	39.19	13.79	-0.59	0.553	--
	Female	50	36.48	11.38			
TAI	Male	21	30.76	5.72	-0.90	0.371	--
	Female	50	30.72	3.83			

SD: Standart Deviation, d: Cohen's effect size, SAI: State Anxiety Inventory, TAI: Trait Anxiety Inventory

Table 5. Mann Whitney U test results regarding the comparison of SAI and TAI scores of the patient group according to pain status

Variable	Postoperative Pain	N	mean	SD	Z	*p*	*d*
SAI	Pain-free	46	30.02	4.95	-6.62	0.000*	0.786
	Painful	25	50.64	9.72			
TAI	Pain-free	46	30.41	4.88	-1.45	0.147	--
	Painful	25	31.32	3.45			

*: $p<0.05$, SD: Standart Deviation, d: Cohen's effect size, SAI: State Anxiety Inventory, TAI: Trait Anxiety Inventory

When the disability levels of the patients are compared with the SAI and TAI scores, it is seen that the SAI scores of the patients are statistically significantly different according to their physical disability status ($p=0.000$). The Mann-Whitney U test was performed to determine which group or groups caused the statistical difference, and according to the study design, the SAI scores of patients with disability (Group 3 and above) were higher than those without disability (Groups 1 and 2). According to our statistical analysis, the TAI scores of the patients did not differ significantly according to the physical disability of the patient group ($p=0.261$) (Table 6).

In another part of the analysis, the anxiety scores of the patient group were compared in terms of the time elapsed after surgery; it was found that there was no statistically significant difference between the SAI and TAI scores of the patients in the early postoperative and late postoperative period (SAI $p=0.584$, TAI $p=0.441$) (Table 7).

Table 6. Kruskal Wallis H test results regarding the comparison of SAI and TAI scores of the patient group according to their disability levels

Variable	Disability (ODI)	N	Mean	SD	H	sd	*p*	Difference (Mann-Whitney)
SAI	1-Minimal disability	32	29.81	3.89	43.25	3	0.000*	3>1 4>2 3>2 4>1
	2-Moderate disability	14	31.50	10.34				
	3-Severe disability	15	47.07	7.82				
	4-Crippled	10	54.60	9.72				
	5-Bed bound / Exaggerating	0						
TAI	1-Minimal disability	32	30.94	5.51	4.00	3	0.261	
	2-Moderate disability	14	29.21	2.81				
	3-Severe disability	15	31.60	2.92				
	4-Crippled	10	30.90	4.25				
	5-Bed bound / Exaggerating	0						

*: $p<0.05$, SD: Standart Deviation, ODI: Oswestry Disability Index, SAI: State Anxiety Inventory, TAI: Trait Anxiety Inventory

Table 7. Mann Whitney U test results for the comparison of SAI and TAI scores of the patient group according to the time elapsed after surgery

Variable	Postoperative Period	N	Mean	SD	Z	*p*	*d*
SAI	Early	37	36.38	11.15	-0.55	0.584	--
	Late	34	38.26	13.16			
TAI	Early	37	30.32	4.12	-0.77	0.441	--
	Late	34	31.18	4.76			

SD: Standart Deviation, d: Cohen's effect size, SAI: State Anxiety Inventory, TAI: Trait Anxiety Inventory

In the last stage of the analyses, the patient group was grouped in terms of postoperative pain and period, and these groups were compared in terms of SAI and TAI scores (Table 8). According to Table 8, it is revealed that patients' SAI scores differ between the groups determined when postoperative pain and period are evaluated together (*p*=0.000). Pairwise groups were formed to determine which group this difference originated from, and Mann-Whitney U tests were performed. As a result of the pairwise comparisons, it was found that the painful early postoperative and painful late postoperative groups had higher SAI scores compared to both pain-free early postoperative and pain-free late postoperative groups. Within the groups with only painful or pain-free patients, SAI scores did not differ in terms of postoperative period. Patients' TAI scores did not show a statistically significant difference between the groups (*p*=0.346).

Table 8. Kruskal Wallis H test results regarding the comparison of SAI and TAI scores of the patient group by considering postoperative pain and period together

Variable	Pain and Period	N	Mean	SD	H	sd	*p*	Diffrence (Mann-Whitney)
SAI	Pain-free and early (1)	23	29.48	4.60	44.75	3	0.000*	1>3 1>4 2>3 2>4
	Pain-free and late (2)	23	30.57	5.32				
	Painful and early (3)	14	47.71	9.28				
	Painful and late (4)	11	54.36	9.35				
TAI	Pain-free and early (1)	23	29.70	4.31	3.31	3	0.346	--
	Pain-free and late (2)	23	31.13	5.40				
	Painful and early (3)	14	31.36	3.71				
	Painful and late (4)	11	31.27	3.26				

*p<0.05, SD: Standart Deviation, SAI: State Anxiety Inventory, TAI: Trait Anxiety Inventory, 1: Painful and early, 2: Painful and late
3: Pain-free and early, 4: Pain-free and late

Discussion

In this study, we found that SAI and TAI scores were significantly higher in the patient group who underwent surgery for DLSS compared to healthy controls; within the study group, SAI and TAI scores were not affected by gender and postoperative period, but higher SAI scores were observed in patients with tremendous postoperative pain and disability, while TAI scores remained unchanged. We also designed a unique model in which postoperative pain and duration were evaluated together to prevent bias arising from the pain factor when analyzing the change in anxiety scores over time after surgery. In this model, we confirmed that the difference between the groups originated from the pain variable; when the pain status was not a variable, SAI, and TAI scores did not differ in terms of postoperative duration. In this respect, our study has the feature of being the first in the literature.

Spine surgeries generally play a role in alleviating or exacerbating depressive and anxiety symptoms in patients with spine problems. Although the words depression and anxiety are uttered in this and similar studies, what is meant is depressive and/or anxiety-related symptoms. The scales were used to measure the levels of depressive and anxiety symptoms, not the levels of depression or anxiety. These depressive and anxiety symptoms decrease in patients as symptoms due to the spine improve after surgery. At the same time, new psychiatric problems are encountered in patients who experience negativity during the postoperative recovery process or suffer from physical disabilities [30]. Previous studies have focused mainly on psychiatric issues in the preoperative period, often conflating anxiety and depression. However, it is a known fact that anxiety and depression represent different clinical conditions. The earliest study on postoperative anxiety, conducted by Surman in 1987 [31], reported more postoperative complications in patients with high levels of anxiety. Falavigna et al. [32] have recently shown that postoperative psychiatric conditions are more critical than preoperative psychiatric conditions in predicting poor quality of life and disability after surgery. Subsequently, Angelini et al. [33] found that the incidence of postoperative anxiety in elective lumbar surgeries was high and affected clinical recovery negatively. We believe that this study, which addresses the anxiety status of patients who have undergone spine surgery in the postoperative period without clustering with depression, is valuable in terms of the information it provides.

The results of this study showing higher levels of state and trait anxiety in patients who underwent surgery for DLSS compared to the healthy controls are consistent with similar studies in the literature. Zieger et al. [15] reported that patients who underwent surgery for lumbar disc herniation had increased levels of anxiety and depression compared to the average population, which negatively affected postoperative pain and returned to work. Another study with 495 spinal surgery patients reported new-onset depression and anxiety rates of 6% and 11.2%, respectively [20]. While the increase in state anxiety levels in the patient group compared to the healthy population can be seen as an understandable result, the high score in trait anxiety may have two reasons. First, this result may be due to the nature of the measurement tool we preferred to use in our study. It has been shown in several studies that the SAI and TAI scales can successfully measure anxiety in populations and represent the theoretical distinction between state and trait anxiety [23, 34, 35]. However, in some exceptional cases and selected populations, it has been observed that the increase in state anxiety levels affects the participants' trait anxiety scores as well [36]. Second, due to DLSS and symptoms such as pain and disability, patients may have developed generalized anxiety in the preoperative period. In addition to these, interpreting the high level of trait anxiety in the patient group as an independent psychiatric condition rather than a disease state would be too theoretical and not consistent with the fact that randomly selected patients with anxiety disorders are grouped in the study population.

Effective management of postoperative anxiety, pain, and physical disability is essential for reducing complications, accelerating recovery, and enhancing patient satisfaction [37]. It has been shown that postoperative pain and physical disability trigger anxiety and depressive symptoms in patients undergoing spinal surgery and generally decrease their quality of life [38-40]. The consensus is that there is a bidirectional and cumulative relationship between back pain and anxiety after spinal surgery. In addition to pain triggering anxiety and depression, the increase in these psychiatric disorders also worsens pain symptoms [41-44]. Jimenez Almonte et al. [45] found that there was no relationship between psychiatric disorders and physical disability in patients undergoing spinal surgery. Still, there was a significant relationship between postoperative pain and anxiety. In another study, Inci and Senol [46] reported a relationship between postoperative pain and anxiety in patients with DLSS. In the same study, they showed that anxiety and depression scores were also high in patients with high levels of disability but not statistically significant. Our study found that patients with higher levels of pain and physical disability had increased state anxiety-related symptom levels. Still, there was no difference in terms of continuous anxiety levels compared to other patients. This result highlights the coexistence of pain, disability, and anxiety but does not clarify the causal mechanisms. But, it is valuable in demonstrating the coexistence of pain, disability, and anxiety in patients who have undergone spinal surgery.

There was no difference in SAI and TAI scores between patients who had undergone surgery for DLSS and had passed three months or less and those who had passed more than three months but less than six months after surgery. Additionally, patients were divided into four groups based on their pain and time variables: early postoperative with pain, late postoperative with pain, early postoperative without pain, and late postoperative without pain, to prevent bias on the results caused by postoperative pain as a variable. These groups were compared in terms of SAI and TAI scores. In this model, it was observed that postoperative duration was not related to either state or trait anxiety and that the pain variable was related to state anxiety but not to trait anxiety score level.

The sample size is the most significant limitation of our study. More extensive sample studies are needed to test the changes in SAI and TAI scores by age and gender more accurately. Another limitation is that patient data are based on self-reports. Structured clinical interview-based studies will provide more accurate results. The standardization of the surgical technique applied seems to be an advantage in terms of the power of the study. However, posterior stabilization surgeries have become quite diverse today. For example, dynamic stabilization systems are thought to provide patients a more comfortable postoperative recovery process [47]. In this context, our study reflects the results of classical rigid stabilization surgeries. On the other hand, we did not take an active role in the postoperative rehabilitation processes of the patients we included in our study. We do not know how they continued these rehabilitation processes. However, studies show that standardized physical rehabilitation processes positively affect patients' physical and mental well-being [48]. Additionally, more extended follow-up periods may be required to understand the relationships between symptoms related to the spine and mental health.

According to the results of our study, the anxiety levels of patients who underwent surgery due to DLSS are generally higher than those of the healthy controls. Additionally, individuals with more pain and physical disability in these patients have higher anxiety symptom levels specific to their situation compared to other patients. We believe that a comprehensive approach focusing on pain, physical disabilities, and anxiety is necessary to support the postoperative recovery process of patients who have undergone surgery due to a degenerative spine. Comprehensive approaches focusing on pain, disability, and anxiety symptoms may positively affect the recovery process. More extensive and prospective studies are needed to reveal the causal relationship between these concepts.

Funding: The author(s) received no financial support for the research, authorship, and/or publication of this article.

Authors contributions: M.E.E., G.U. and E.F.E. constructed the main idea and hypothesis of the study. M.E.T., H.D., M.E.E. and E.F.E. developed the theory and arranged/edited the material and method section. M.E.E., E.F.E., G.U. have done the evaluation of the data in the results section. Discussion section of the article written by M.E.E., E.F.E. and M.E.T. M.E.T. and H.D. reviewed, corrected and approved. In addition, all authors discussed the entire study and approved the final version.

Conflict of interest: No conflict of interest was declared by the authors.

References

1. Ravindra VM, Senglaub SS, Rattani A, et al. Degenerative Lumbar Spine Disease: Estimating Global Incidence and Worldwide Volume. *Global Spine J*. Dec 2018;8(8):784-794. doi:10.1177/2192568218770769
2. Bydon M, Alvi MA, Goyal A. Degenerative Lumbar Spondylolisthesis: Definition, Natural History, Conservative Management, and Surgical Treatment. *Neurosurg Clin N Am*. Jul 2019;30(3):299-304. doi:10.1016/j.nec.2019.02.003
3. Hughey AB, Lesniak MS, Ansari SA, Roth S. What will anesthesiologists be anesthetizing? Trends in neurosurgical procedure usage. *Anesth Analg*. Jun 1 2010;110(6):1686-1697. doi:10.1213/ANE.0b013e3181cbd9cc
4. Katz JN, Zimmerman ZE, Mass H, Makhni MC. Diagnosis and Management of Lumbar Spinal Stenosis: A Review. *Jama*. May 3 2022;327(17):1688-1699. doi:10.1001/jama.2022.5921
5. Martinez Urrutia A. Anxiety and pain in surgical patients. *J Consult Clin Psychol*. Aug 1975;43(4):437-442. doi:10.1037/h0076898
6. Darnall BD. Pain Psychology and Pain Catastrophizing in the Perioperative Setting: A Review of Impacts, Interventions, and Unmet Needs. *Hand Clin*. Feb 2016;32(1):33-39. doi:10.1016/j.hcl.2015.08.005
7. Polatin PB, Kinney RK, Gatchel RJ, Lillo E, Mayer TG. Psychiatric illness and chronic low-back pain. The mind and the spine--which goes first? *Spine (Phila Pa 1976)*. Jan 1993;18(1):66-71. doi:10.1097/00007632-199301000-00011
8. Härter M, Reuter K, Weisser B, Schretzmann B, Aschenbrenner A, Bengel J. A descriptive study of psychiatric disorders and psychosocial burden in rehabilitation patients with musculoskeletal diseases. *Arch Phys Med Rehabil*. Apr 2002;83(4):461-468. doi:10.1053/apmr.2002.30924
9. Rusinov V. Anxiety among Adults Undergoing Elective Lumbar Spine Surgery at University of California–San Diego Medical Center–La Jolla. 2022.
10. Held U, Burgstaller JM, Deforth M, Steurer J, Pichierri G, Wertli MM. Association between depression and anxiety on symptom and function after surgery for lumbar spinal stenosis. *Sci Rep*. Feb 18 2022;12(1):2821. doi:10.1038/s41598-022-06797-1
11. Lebow R, Parker SL, Adogwa O, et al. Microdiscectomy improves pain-associated depression, somatic anxiety, and mental well-being in patients with herniated lumbar disc. *Neurosurgery*. Feb 2012;70(2):306-311; discussion 311. doi:10.1227/NEU.0b013e3182302ec3.
12. Theunissen M, Peters ML, Bruce J, Gramke HF, Marcus MA. Preoperative anxiety and catastrophizing: a systematic review and meta-analysis of the association with chronic postsurgical pain. *Clin J Pain*. Nov-Dec 2012;28(9):819-841. doi:10.1097/AJP.0b013e31824549d6
13. Goyal DKC, Stull JD, Divi SN, et al. Combined Depression and Anxiety Influence Patient-Reported Outcomes after Lumbar Fusion. *Int J Spine Surg*. Apr 2021;15(2):234-242. doi:10.14444/8008
14. Jackson KL, Rumley J, Griffith M, Agochukwu U, DeVine J. Correlating Psychological Comorbidities and Outcomes After Spine Surgery. *Global Spine J*. Oct 2020;10(7):929-939. doi:10.1177/2192568219886595
15. Zieger M, Schwarz R, König HH, Härter M, Riedel Heller SG. Depression and anxiety in patients undergoing herniated disc surgery: relevant but underresearched - a systematic review. *Cent Eur Neurosurg*. Feb 2010;71(1):26-34. doi:10.1055/s-0029-1225325
16. Robleda G, Sillero Sillero A, Puig T, Gich I, Baños JE. Influence of preoperative emotional state on postoperative pain following orthopedic and trauma surgery. *Rev Lat Am Enfermagem*. Oct 2014;22(5):785-791. doi:10.1590/0104-1169.0118.2481
17. Netto MB, Barranco ABS, Oliveira KWK, Petronilho F. Influence of anxiety and depression symptoms on the quality of life in patients undergoing lumbar spine surgery. *Rev Bras Ortop*. Jan-Feb 2018;53(1):38-44. doi:10.1016/j.rboe.2017.01.009
18. Dunn LK, Durieux ME, Fernández LG, et al. Influence of catastrophizing, anxiety, and depression on in-hospital opioid consumption, pain, and quality of recovery after adult spine surgery. *J Neurosurg Spine*. Jan 2018;28(1):119-126. doi:10.3171/2017.5.Spine1734
19. Aalto TJ, Malmivaara A, Kovacs F, et al. Preoperative predictors for postoperative clinical outcome in lumbar spinal stenosis: systematic review. *Spine (Phila Pa 1976)*. Aug 15 2006;31(18):E648-663. doi:10.1097/01.brs.0000231727.88477.da
20. Bekeris J, Wilson LA, Fiasconaro M, et al. New Onset Depression and Anxiety After Spinal Fusion Surgery: Incidence and Risk Factors. *Spine (Phila Pa 1976)*. Aug 15 2020;45(16):1161-1169. doi:10.1097/brs.0000000000003467
21. Spielberger CD, Gonzalez Reigosa F, Martinez Urrutia A, Natalicio LFS, Natalicio DS. The state-trait anxiety inventory. *Interamerican Journal of Psychology*. 1971;5:145-158.
22. Beneciuk JM, Robinson ME, George SZ. Subgrouping for patients with low back pain: a multidimensional approach incorporating cluster analysis and the STarT Back Screening Tool. *J Pain*. Jan 2015;16(1):19-30. doi:10.1016/j.jpain.2014.10.004

23. Oei TP, Evans L, Crook GM. Utility and validity of the STAI with anxiety disorder patients. *Br J Clin Psychol*. Nov 1990;29(4):429-432. doi:10.1111/j.2044-8260.1990.tb00906.x
24. Huskisson EC. Measurement of pain. *Lancet*. Nov 9 1974;2(7889):1127-1131. doi:10.1016/s0140-6736(74)90884-8
25. Fairbank J. Revised Oswestry Disability questionnaire. *Spine (Phila Pa 1976)*. Oct 1 2000;25(19):2552. doi:10.1097/00007632-200010010-00025
26. Yakut E, Düger T, Oksüz C, et al. Validation of the Turkish version of the Oswestry Disability Index for patients with low back pain. *Spine (Phila Pa 1976)*. Mar 1 2004;29(5):581-585; discussion 585. doi:10.1097/01.brs.0000113869.13209.03
27. Boonstra AM, Schiphorst Preuper HR, Balk GA, Stewart RE. Cut-off points for mild, moderate, and severe pain on the visual analogue scale for pain in patients with chronic musculoskeletal pain. *PAIN®*. 2014/12/01/ 2014;155(12):2545-2550. doi:10.1016/j.pain.2014.09.014
28. Collins SL, Moore RA, McQuay HJ. The visual analogue pain intensity scale: what is moderate pain in millimetres? *Pain*. Aug 1997;72(1-2):95-97. doi:10.1016/s0304-3959(97)00005-5
29. Shafshak TS, Elnemr R. The Visual Analogue Scale Versus Numerical Rating Scale in Measuring Pain Severity and Predicting Disability in Low Back Pain. *J Clin Rheumatol*. Oct 1 2021;27(7):282-285. doi:10.1097/rhu.0000000000001320
30. Rahman R, Ibaseta A, Reidler JS, et al. Changes in patients' depression and anxiety associated with changes in patient-reported outcomes after spine surgery. *J Neurosurg Spine*. Jan 31 2020:1-20. doi:10.3171/2019.11.Spine19586
31. Surman OS. The surgical patient, Massachusetts General Hospital Handbook of General Hospital Psychiatry. TP Hackett, NH Cassem (Ed), 2. Baskı, Littleton. PSG Publishing; 1987.
32. Falavigna A, Righesso O, Teles AR, et al. Responsiveness of depression and its influence on surgical outcomes of lumbar degenerative diseases. *Eur J Orthop Surg Traumatol*. Jul 2015;25 Suppl 1:S35-41. doi:10.1007/s00590-015-1651-0
33. Angelini E, Wijk H, Brisby H, Baranto A. Patients' Experiences of Pain Have an Impact on Their Pain Management Attitudes and Strategies. *Pain Manag Nurs*. Oct 2018;19(5):464-473. doi:10.1016/j.pmn.2018.02.067
34. Guillén Riquelme A, Buela Casal G. Meta-analysis of group comparison and meta-analysis of reliability generalization of the State-Trait Anxiety Inventory Questionnaire (STAI). *Rev Esp Salud Publica*. Jan-Feb 2014;88(1):101-112. doi:10.4321/s1135-57272014000100007
35. Forrest SJ, Siegert RJ, Krägeloh CU, Landon J, Medvedev ON. Generalizability theory distinguishes between state and trait anxiety. *Psychol Assess*. Nov 2021;33(11):1080-1088. doi:10.1037/pas0001060
36. Leal PC, Goes TC, da Silva LCF, Teixeira Silva F. Trait vs. state anxiety in different threatening situations. *Trends Psychiatry Psychother*. Jul-Sep 2017;39(3):147-157. doi:10.1590/2237-6089-2016-0044
37. Glowacki D. Effective pain management and improvements in patients' outcomes and satisfaction. *Crit Care Nurse*. Jun 2015;35(3):33-41; quiz 43. doi:10.4037/ccn2015440
38. Wilson BR, Tringale KR, Hirshman BR, et al. Depression After Spinal Surgery: A Comparative Analysis of the California Outcomes Database. *Mayo Clin Proc*. Jan 2017;92(1):88-97. doi:10.1016/j.mayocp.2016.06.030
39. Otani K, Kikuchi S, Yabuki S, et al. Lumbar spinal stenosis has a negative impact on quality of life compared with other comorbidities: an epidemiological cross-sectional study of 1862 community-dwelling individuals. *ScientificWorldJournal*. 2013;2013:590652. doi:10.1155/2013/590652
40. Jackson T, Tian P, Wang Y, Iezzi T, Xie W. Toward Identifying Moderators of Associations Between Presurgery Emotional Distress and Postoperative Pain Outcomes: A Meta-Analysis of Longitudinal Studies. *J Pain*. Aug 2016;17(8):874-888. doi:10.1016/j.jpain.2016.04.003
41. Coronado RA, George SZ, Devin CJ, Wegener ST, Archer KR. Pain Sensitivity and Pain Catastrophizing Are Associated With Persistent Pain and Disability After Lumbar Spine Surgery. *Arch Phys Med Rehabil*. Oct 2015;96(10):1763-70. doi:10.1016/j.apmr.2015.06.003
42. Costelloe C, Burns S, Yong RJ, Kaye AD, Urman RD. An Analysis of Predictors of Persistent Postoperative Pain in Spine Surgery. *Curr Pain Headache Rep*. Feb 18 2020;24(4):11. doi:10.1007/s11916-020-0842-5
43. Fernandez M, Colodro Conde L, Hartvigsen J, et al. Chronic low back pain and the risk of depression or anxiety symptoms: insights from a longitudinal twin study. *Spine J*. Jul 2017;17(7):905-912. doi:10.1016/j.spinee.2017.02.009
44. Cimilli C. Anxiety in Surgery. *Turkish Journal of Clinical Psychiatry*. 2001;4(3):182-186.
45. Jiménez Almonte JH, Hautala GS, Abbenhaus EJ, et al. Spine patients demystified: what are the predictive factors of poor surgical outcome in patients after elective cervical and lumbar spine surgery? *Spine J*. Oct 2020;20(10):1529-1534. doi:10.1016/j.spinee.2020.05.550
46. İnci A, Şenol N. Evaluation of patients with degenerative lumbar spinal stenosis after surgery in terms of anxiety and depression. *Medical Journal of Süleyman Demirel University*. 2014;21(1):7-10.

47. Ozer AF, Oktenoglu T, Egemen E, et al. Lumbar Single-Level Dynamic Stabilization with Semi-Rigid and Full Dynamic Systems: A Retrospective Clinical and Radiological Analysis of 71 Patients. *Clin Orthop Surg*. Sep 2017;9(3):310-316. doi:10.4055/cios.2017.9.3.310
48. Canbulat N, Oktenoglu T, Ataker Y, et al. A Rehabilitation Protocol for Patients with Lumbar Degenerative Disc Disease Treated with Posterior Transpedicular Dynamic Stabilization. *Turk Neurosurg*. 2017;27(3):426-435. doi:10.5137/1019-5149.Jtn.16326-15.1