Acıbadem Univ. Sağlık Bilim. Derg. 2024; 15 (4)
https://doi.org/10.31067/acusaglik.1407100

Effect of Spinal Surgery on Quality of Life in Patients with Chronic Low Back Pain, Clinical Study Evaluated with The SF-36 Quality of Life Scale

Şule Göktürk[1], **Yasin Göktürk**[1]

[1] Department of Neurosurgery, University of Health Sciences, Kayseri City Hospital, Kayseri, Turkey

ABSTRACT

Aim: Chronic low back pain is a disabling condition degrading peoples quality of life. Low back pain is the most common disease that neurosurgeons encounter in practice and the most common complaint that requires admission to outpatient clinics. Although the incidence of low back pain in the general population is 5% and 90% of the cases heal spontaneously within one month. In our study, the results of the quality of life scale of the patients who applied with the complaint of chronic low back pain within the clinical course and who had undergone spinal surgery and those who did not, were compared.

Material and Methods: 110 patients with chronic low back pain (chronic low back pain: lasting more than 12 weeks), who had undergone lumbar spinal surgery and who had not, were included in the study. Patients with chronic low back pain who underwent spinal surgery and not undergoing spinal surgery were compared with SF-36 quality of life outcome scale. The statistical significance level was accepted as $p<0.05$ in the calculations.

Results: Physical functionality, emotional role difficulty, social functionality, pain and general health perception sub-dimensions of quality of life were found to be statistically significantly higher in males ($p<0.05$). In our study, physical functionality (for example, activities that require physical effort such as walking), physical role difficulty, emotional role difficulty and general health perception scores were found to be significantly lower in patients with a history of spinal surgery ($p<0.05$), and also social functionality (for example, going to a neighbor's), scores were found to be significantly lower in those with a history of surgery (p:0.087).

Conclusion: When the early results of the surgical treatment for chronic low back pain are evaluated, it is seen that the pain is reduced and often eliminated, but it has been observed that it does not help the patients regain the correct body image, improve their functional abilities, and improve their quality of life in long-term follow-ups. In this case, before the surgery, especially the histories of the patients should be taken well, their expectations should be questioned, the benefits they can gain from surgery according to their age should be taken into account, the expectations and lifestyles of the people in the postoperative process are also extremely effective in well-being, no matter how good surgery is performed.

Key words: Spinal surgery, chronic low back pain, quality of life scale.

Şule GÖKTÜRK
0000-0001-6590-4885

Yasin GÖKTÜRK
0000 0002 4779 9927

Correspondence: Şule Göktürk
Department of Neurosurgery, University of Health Sciences, Kayseri City Hospital, Kayseri, Turkey
Phone: +90 532 393 81 95
E-mail: suleGOKTURK@outlook.com

Received: 19.12.2023
Accepted: 07.02.2024

ÖZET

Amaç: Kronik bel ağrısı, insanların yaşam kalitesini düşüren ve sosyal yaşamlarını kısıtlayan bir durumdur. Bel ağrısı, beyin cerrahlarının pratikte ve özellikle polikliniklerde en sık karşılaştığı şikayettir. Genel popülasyonda bel ağrısı insidansı %5 tir ve vakaların %90'ı bir ay içinde kendiliğinden iyileşir. Çalışmamızda, klinik seyir ve radyolojik bulgular dahilinde kronik bel ağrısı şikayeti ile başvuran ve, spinal cerrahi geçirmiş ve geçirmemiş hastaların yaşam kalite ölçeği sonuçları, hastaların Beden Kitle İndeksleri de çalışmaya dahil edilerek karşılaştırılmıştır.

Gereç ve Yöntem: Çalışmaya kronik bel ağrısı olan (kronik bel ağrısı:12 haftanın üzerinde süren), lomber spinal cerrahi geçirmiş ve geçirmemiş 110 hasta dahil edilmiştir. Çalışmamızda, lomber spinal cerrahi geçiren ve geçirmeyen hastaların yaşam kaliteleri, SF-36 yaşam kalite ölçeği kullanılarak karşılaştırılmış ve sonuçları değerlendirilmiştir. İstatistiksel olarak farkın önemliliği $p<0.05$ olarak kabul edilmiştir.

Bulgular: Yaşam kalitesinin fiziksel işlevsellik, emosyonel rol zorluğu, sosyal işlevsellik, ağrı ve genel sağlık algısı alt boyutlarının erkeklerde istatistiksel olarak anlamlı düzeyde yüksek olduğu belirlendi ($p<0,05$). Çalışmamızda omurga cerrahisi öyküsü olan hastalarda fiziksel işlevsellik (örneğin yürüme gibi fiziksel efor gerektiren aktiviteler), fiziksel rol zorluğu, emosyonel rol zorluğu ve genel sağlık algısı puanları anlamlı olarak düşük bulunmuştur ($p<0,05$), ve ayrıca sosyal işlevsellik (örneğin komşuya gitmek) skorlarının ameliyat öyküsü olanlarda anlamlı olarak daha düşük olduğu belirlenmiştir (p:0,087).

Tartışma ve Sonuç: Kronik bel ağrılı hastalara, ağrıyı azaltmaya yönelik yapılan cerrahi tedavinin erken dönem sonuçları değerlendirildiğinde ağrıyı azalttığı ve çoğu zaman ortadan kaldırdığı görülmekle birlikte uzun dönem takiplerde tek başına, hastaların doğru vücut algısını yeniden kazanmalarına, fonksiyonel yeteneklerini geliştirmelerine, yaşam kalitelerini iyileştirmelerine yardımcı olmadığı gözlenmiştir. Bu durumda ameliyat öncesi özellikle hastaların öyküleri iyi alınmalı, beklentileri sorgulanmalı, yaşlarına göre ameliyattan elde edebilecekleri faydalar dikkate alınmalı, bölgedeki kişilerin beklentileri ve yaşam tarzları dikkate alınmalıdır. Ameliyat ne kadar iyi yapılırsa yapılsın ameliyat sonrası süreç de sağlık açısından son derece etkilidir.

Anahtar Kelimeler: Spinal cerrahi, kronik bel ağrısı, yaşam kalitesi ölçeği.

Low back pain, commonly referred to as lumbalgia, is a prevalent condition encountered by treating surgeons and is a leading cause of outpatient clinic referrals. Sciatica, often associated with compression of sciatic nerve-forming roots, is a common manifestation. Originating from the 4th century by Hippocrates, the term 'sciatica' underscores the historical significance of this ailment (1). Lumbar disc herniation stands out as the primary cause of low back pain, with additional contributors such as degenerative spine disease, lumbar stenosis, spondylolisthesis, malignancies, and infections. The risk factors for disc herniation are similar to those seen in low back pain. Low back pain is among the first diseases that cause loss of work power (2).

The economic impact of low back pain is substantial, emphasizing the need for a comprehensive understanding, especially in developing societies. It is obvious that if a healthy database is created in developing and industrializing societies like our country, the results will not be much different (3).

In developed societies, a large financial resource has been allocated to degenerative spine disease, which is one of the causes of low back pain, and treatment algorithms for this disease are applied quite regularly. Despite significant attention and resources allocated to degenerative spine disease in developed societies, low back problems persist as almost intrinsic to modern lifestyles. The conscious and comfortable access of these high socio-cultural communities to hospitals also reveals the sufficient number of patients (3). While the prevalence of low back pain is 5%, approximately 80% of individuals experience it at some point in their lives (4). The challenge lies in the fact that only 15% of cases receive an etiological diagnosis. A majority of patients don't seek medical consultation due to natural resolution within a month. The risk of disc herniation is 2-5%, with surgical intervention limited to a mere 2% (5). Young-middle age, male gender, familial predisposition, environmental factors and previous trauma are common risk factors. Although there is a significant increase in low back pain with age, the incidence of disc herniation decreases (5).

In patients presenting with low back pain, examination begins with inspection. Especially if there is a disc herniation, patients try to take a suitable position to relax the nerve root. This posture is called the 'antalgic' posture. The Laseque test, the "opposite leg stretch" test described by Fajerszdahn, is used in the examination of disc herniations. In the muscle strength examination, all muscle groups are examined one by one. Trauma, neoplasia, and signs of infection are also questioned while taking a history. In the differential diagnosis of low back pain, radiological evaluation can also be performed in addition to the history and physical examination. These are, in order; direct radiographs, computed tomography (CT), Magnetic Resonance Imaging (MR), Myelography. In fact, chronic pain is often described as an unpleasant sensory or emotional experience, and low back pain is also extremely common and is cited as the second most common reason people seek medical attention.

Low back pain or lumbalgia is one of the most common types of chronic pain in neurosurgery practice; It has been proven in clinical studies that it also causes anxiety, depression, sleep disorders, low quality of life and high health services (6,7). Low back pain is the most common cause of disability in people under the age of 45. It constitutes 15% of the workforce losses caused by the disease. Lifetime prevalence estimates range from 80-90%, with an annual incidence of 5% (8). Both chronic pain and deterioration of functional status can reduce the quality of life of patients. Quality of Life is defined as "subjective well-being" or, in other words, "the state of being satisfied with one's own life". The World Health Organization has similarly defined quality of life as "the way an individual perceives his/her own situation in life in the context of both the cultural and the value judgments of the environment, as well as his/her own goals, expectations, standards and interests".

There are many reasons to evaluate health-related quality of life in patients with low back pain. It provides potentially useful information for the clinician in assessing care needs, establishing treatment goals and planning treatment, monitoring the patient out of hours, and evaluating treatment outcomes (9). The scale consists of 36 items and these provide the measurement of 8 dimensions:

Physical functions, social functions, inhibition in roles due to physical problems, physical pain, mental health, inhibition in roles due to emotional problems, life energy, general health perception. The QOLS is scored by adding up the score on each item to yield a total score for the instrument. Scores can range from 16 to 112. There is no automated administration or scoring software for the QofLS (10).

Recognizing the socio-demographic factors and the scarcity of studies in the country, an investigation into the quality of life for chronic low back pain patients becomes imperative. Therefore, this study aims to fill the existing gap in the literature by evaluating the quality of life, physical and social functions of patients experiencing chronic low back pain (lasting more than 12 weeks) by utilizing the SF-36 scale. By raising awareness among health professionals, the study aspires to contribute to preventive measures and minimize workforce losses associated with this prevalent health issue.

Material and Method

Patient Population

This epidemiologic retrospective correlational study was conducted among suitable patients with chronic low back pain who sought treatment at the Neurosurgery Clinic of Kayseri City Hospital between April and July 2022. A power analysis during the biostatistical preliminary assessment indicated a study population 110 cases to show a clinically important difference for lumbar surgery. Research data were collected from patients attending the outpatient clinic of the University of Health Sciences, Kayseri City Hospital, Neurosurgery Clinic.

Inclusion-Exclusion Criteria and Demographic Data

The study included 110 patients with chronic low back pain, aged between 18-75, irrespective of gender, and both those who had experienced and not experienced chronic low back pain. Demographic data encompassed parameters such as height (cm), body weight (kg), and Body Mass Index (BMI). These measurements were taken with precision using a weight and height measurement device while patients were barefoot and dressed in sportswear.

Evaluation Criteria

Patient groups were evaluated through one-on-one interviews with physicians using the SF-36 Quality of Life form. This form assesses positive and negative aspects of life quality, where a higher score indicates a better quality of life. Additionally, patients' spinal surgery history was considered. The study aims to compare and evaluate the results of patients who underwent single or two-level microdiscectomy, posterior stabilization, and arthrodesis surgery within 2 to 6 segments, patients who underwent spinal stenosis surgery without single-level arthrodesis, and those who did not undergo spinal surgery using the SF-36 Quality of Life scale. Minimally invasive procedures (kyphoplasty, vertebroplasty, endoscopic discectomy) were not included in the study. None of the patients included in the study were found to have early surgical complications, the need for a second surgery, or that not reducing the pain. All of the patients were discharged with surgical cure.

Statistical Analysis

Data for the study were recorded and analyzed using the SPSS 22 program. The Shapiro-Wilk test was employed to assess the normal distribution of data. For the statistical analysis of quantitative data, Unpaired t-Test was utilized for normally distributed values, and Mann Whitney-U test for non-normally distributed values. One-Sample t-test was applied to evaluate mean scores of Quality-of-Life Scale (QofLS) for patients in comparison to the Turkish population. Pearson Chi-square test was used for the statistical analysis of categorical data, and Pearson Correlation coefficient was employed to demonstrate relationships between variables. Statistical significance was accepted at $p<0.05$.

Results

A total of 110 patients suffering from chronic low back pain, with a duration exceeding 12 weeks, were enrolled from the Neurosurgery outpatient clinic at Kayseri City Hospital. Among these participants, 71.8% were female, and the mean age was 45.79±15.29 years. Notably, 30.9% of the patients had a history of previous spinal surgery, including procedures such as lumbar discectomy, spinal stenosis treatment, and posterior instrumentation.

The overall mean Body Mass Index (BMI) for the entire cohort was calculated as 28.22±5.35 kg/m2. Demographic analysis revealed no significant age or BMI differences between genders, yet a higher prevalence of previous spinal surgery among women was observed (**Table 1**).

Table 1: Surgical history, age and average BMI are given by gender.

Feature		Gender				p	
		Female (n:79)		Male (n:31)			
		Mean	SD.	Mean	SD:		
Age		45.86	15.38	45.61	15.30	0,939*	
BMI		28.66 Hydrangea:28.65	5.73	27.11 Hydrangea:27.14	4.11	0,174**	
		n	%	n	%	p	
BMI group	**Normal**	25	31.6	8	25.8	**0,010*** **	
	Slightly fat	28	35.4	20	64.5		
	Obese	26	32.9	3	9.7		
Surgical history	**There is**	27	34.2	7	22.6	0,236***	
	None	52	65.8	24	77.4		

Unpaired t Test **, Mann Whitney U Test, * Pearson Chi-Square Test*
BMI:Body Mass Index, LDL:Quality of Life Scale

A comprehensive evaluation of the patients' quality of life included a comparison with Turkish society values and revealed significantly lower scores in all sub-dimensions for the study participants. Gender-based analysis indicated that males exhibited higher scores in physical functionality, emotional role difficulty, social functionality, pain, and general health perception sub-dimensions, with statistical significance (p<0.05) (**Table 2**).

Table 2: Comparison of Quality of Life scores by gender and Turkish population averages

QofL sub dimensions	Female				Male				p[1]
	Patients		Turkish people		Patients		Turkish People		
	Mean	SD.	Mean	SD.	Mean	SD.	Mean	SD.	
Physical Functionality	50.18	24.34	80.6	21.7	60.48	22.03	87.2	17.1	**0,043****
	p<0,001*				p<0,001*				
Physical Role Difficulty	29.74	33.74	82.9	28.6	36.29	35.84	89.8	19.3	0,386***
	p<0,001*				**p<0,001***				
Emotional Role Difficulty	30.37	35.88	89.0	22.5	44.08	35.88	92.8	15.1	**0,048*****
	p<0,001*				**p<0,001****				
Energy Vitality	35.94	21.88	63.4	13.7	42.41	18.34	65.7	11.9	0,148***
	p<0,001*				**p<0,001***				
Mental Health	48.05	21.73	70.1	11.4	53.67	20.46	71.0	10.6	0,217**
	p<0,001*				p<0,001*				
Social Functionality	49.20	24.13	90.1	12.9	59.27	20.40	91.7	12.8	**0,026*****
	p<0,001*				**p<0,001***				
Pain	20.60	15.77	81.0	20.2	29.35	19.68	85.1	16.4	**0,015*****
	p<0,001*				**p<0,001***				
General health	37.08	18.33	69.1	16.9	45.64	18.56	73.6	14.9	0,030**
	p<0,001				p<0,001				

*(p: patients according to Turkish population averages, p1: between female and male patients) *One Sample-t Test,**Unpaired t Test ***Mann Whitney U Test*
QofLS:Quality of Life Scale

However, in other sub-dimensions, while males displayed highermean scores, the differences were not statistically significant (p>0.05). Further scrutiny into patients with a history of spinal surgery unveiled lower scores in physical functionality, physical role difficulty, emotional role difficulty, and general health perception (p<0.05). Social functionality scores were also lower in this subgroup, though not statistically significant (p: 0.087). Moreover, a negative correlation was established between patients' age and their physical functionality scores (p: 0.005, Correlation Coefficient: -0.267), as well as a negative correlation between age and general health perception scores (p:0.019, Correlation Coefficient:-0.233) (**Table 3**).

Table 3: Quality of life scale (QofLS) scores and surgical history of the patients

QofLS sub Dimensiones	Surgical history			
	There is		None	
	Mean	SD.	Mean	SD.
Physical functionality	41.47	21.76	58.28	23.34
	p<0,001*			
Physical Role Difficulty	20.58	30.44	36.51	34.98
	p:0,020*			
Emotional Role Difficulty	22.54	30.39	39.47	37.59
	p:0,026*			
Energy Vitality	33.08	23.90	39.86	19.47
	p:0,119**			
Mental Health	47.64	23.08	50.52	20.76
	p:0,518**			
Social Functionality	45.58	25.35	54.93	22.18
	p:0,087*			
Pain	20.22	16.46	24.34	17.66
	p:0,135*			
General Health	34.26	19.38	41.84	18.05
	p:0,049**			

**Mann Whitney U Test, **Unpaired t Test*
QofLS:Quality of Life Scale

Discussion

In the study, the quality of life of patients who had or had not undergone spine surgery was evaluated with the SF-36 scale, and the Body Mass Index (BMI) values of the patients were also included in the study. The most important finding of this study is that it was obtained by evaluating the results of obesity, low back pain and previous spine surgery together. As a result, it has been observed that patients who have undergone spine surgery and obesity are more common in the female patient population.

While we may not desire it, this study has certain limitations. Firstly, due to its retrospective design, there may be limitations in accessing and verifying retrospective data. Secondly, the reliance on patients' self-reports for the data used in the study may lack objectivity. Evaluations of patients' symptoms or quality of life can be subjective, potentially impacting the reliability of the results

Lastly, although the text mentions that patients with a history of spinal surgery were evaluated in a general category, these patients may have undergone different surgical procedures. This situation could pose challenges in separating the effects of various surgical types. Patients have to be evaluated together with their physical examinations, radiological findings and complaints in deciding the surgical treatment. Although 80% of individuals complain of low back pain at some point in their lives, only 2% of them are treated surgically.

Acutely presented pains that if it is less than 12 weeks old is treated with non-surgical conservative methods, with satisfactory results in most of them. In a study by Chou et al. in the treatment of chronic low back pain; showed that physical therapy, exercise, functional and spinal surgery are also effective and reduce low back pain (12). Alemanno et al. clinically demonstrated that physical therapy applied to 20 patients with chronic low back pain in 2019 reduced their pain and increased their quality of life using the SF-36 scale (13). In our study, although it is expected that surgery may have a positive effect on the quality of life in patients with chronic low back pain who underwent spinal surgery, although their pain decreased in patients of both genders who underwent spinal surgery, their physical functionality, physical role difficulty, emotional role difficulty and general health perception improved in their postoperative follow-up. scores were found to be significantly lower (p<0.05).

Rodrigues et al. randomized sixty-three patients with lumbar canal stenosis into two groups: the patients underwent surgery group and control group. The role of the physical field of SF-36 also showed significant differences between groups. It was observed that lumbar stenosis surgery did not improve pain in the short and medium term, but in the medium term, function and vitality were better in the operated group and patients were more satisfied with the surgical treatment. Researchers emphasize

that appropriate diagnostic procedures and treatments must be implemented to prevent further deterioration of physical functionality and quality of life (14).

In study of Almeida et al. a prospective study was conducted on 9 patients of both genders, aged between 18 and 60, who were scheduled for spine surgery due to degenerative disease in the lumbar segment, and found that the improvement achieved with spine surgery did not have a statistically significant relationship with fatigue, pain and fatigue in the lower extremities and lower back pain (15).

Yamamoto et al. in their study on lumbar spinal stenosis patients who underwent decompression surgery with and without fusion, they determined the medical outcomes before and 6 months after surgery using the SF-36 quality of life scale. Less severe preoperative low back pain was thought to be associated with patient dissatisfaction with lumbar surgery, but not with poorer mental health and higher levels of anxiety, depression, pain-catastrophizing pain or fear avoidance beliefs. The psychological state before and after surgery must be carefully evaluated and managed appropriately (16). Silverplats et al. the quality of life scales of 117 patients who were operated with the diagnosis of lumbar disc herniation between 1998 and 2002 were evaluated at the 2nd and 7th years after surgery. In 85% of the cases, improvement was found in the quality of life scale in the 2nd year after surgery, while improvement was found in 91% of the cases at the end of 7 years (17).

As a result, it seems that a successful surgical intervention and the surgical treatment of the existing pathological condition do not result in a complete perception of well-being in the patient. Of course, from a different perspective, knowing that the disease has relapsed or developed a relapse causes patients to consciously restrict their physical and functional activities. There are many factors such as choosing the right patient before surgical intervention and the information the patient receives about the intervention, the socioeconomic status of the patient and his family and their perception of the disease, the current health status of the patients and the comorbidities they bring with them. Patients have different expectations for recovery from surgical treatment, their professions and working conditions. In addition, our study has shown that choosing the right patient before surgical intervention and informing the patient about the intervention to be performed are of great importance.

Conclusion

In our study, when the patients' quality of life scale scores were compared with the values of Turkish society according to gender, their quality of life scores were found to be significantly lower than in the general population. When the early results of the surgical treatment for chronic low back pain are evaluated, it is seen that the pain is reduced and often eliminated, but it has been observed that it does not help the patients regain the correct body image, improve their functional abilities, and improve their quality of life in long-term follow-ups. In this case, before the surgery, especially the histories of the patients should be taken well, their expectations should be questioned, the benefits they can derive from surgery according to their age should be taken into account, and it should not be forgotten that the expectations and lifestyles of the people in the postoperative process are also extremely effective in well-being, no matter how well the surgery is performed.

Declarations

Funding

This study has not received any financial support.

Conflicts of interest

The authors declare that they have no conflicts of interest regarding this study.

Ethical Consent

The study was approved by the local ethics committee of Nuh Naci Yazgan University (permission dated 22/04/2022 and numbered 2022-8146) and informed consent was obtained from all participants in accordance with the Declaration of Helsinki before they were permitted to complete the survey. Furthermore, approval for the study was granted by the local ethics committee of Kayseri City Hospital, with the ethics committee approval dated 10/05/2022 and numbered 61.

Availability of data and material

The data and material are available upon request.

Author Contributions

In their respective contributions, Op.Dr. GÖKTÜRK Ş. and Op.Dr. GÖKTÜRK Y. have provided insights into the intricacies of the project, encompassing the intricacies of project preparation, data collection, data analysis and statistics, preparation of tables, and the composition of scientific papers.

References

1. Turkish Neurosurgery Society Publications, Basic Neurosurgery, Vol:2, H.Toplamaoğlu, A.Ender Ofluoğlu; Chapter:10, p.1489.
2. MD Bois, M Szpalski, P Donceel, Patients at risk for long-term sick leave because of long back pain. Spine Surgery 1:389-400, 1999.
3. Turkish Neurosurgery Society Publications, Basic Neurosurgery, Vol:2, F.Özer; Chapter :107, p.1509.
4. *RW Hardy. Extradural cauda equina and nerve root comprasion from enign of the lumbar spine. Neurological surgery 1996; 3:2357-74.*
5. *H Weber. Lumbar disc herniation. A prospective study of factors including a controlled trial.J Oslo City Hos 1978; 28;33-64.*
6. *RM Leadley, N Armstrong, KJ Reid et al. Healthy aging in relation to chronic pain and quality of life in Europe. Pain Pract Off J World Inst Pain. 2014; 14: 547–558.*
7. *R Andrew ,S Derry, RS Taylor et al. The costs and consequences of adequately managed chronic non-cancer pain and chronic neuropathic pain. Pain Pract Off J World Inst Pain. 2014; 14: 79–94.*
8. *Handbook of Neurosurgery, Mark S.Greenberg, Part 14, Spine, p.289.*
9. Şahin G, *E Z Hasanefendioğlu, M Sezgin et al. Health-Related Quality of Life in Patients with Chronic Low Back Pain: The Effect of Pain, Clinical and Functional Status on Quality of Life. Turkish Journal of Physics Medicine Rehab 2012;58:93-8.*
10. C S Burckhardt, K L Anderson, The Quality of Life Scale (QOLS): Reliability, Validity, and Utilization, Bio Med Central, 2003;1:60.
11. S Ataoğlu, Comparison of Scales Used to Evaluate Quality of Life in Fibromyalgia Patients. Anadolu Clinic Journal of Medical Sciences, 2017; 22:2,85-94.
12. Chou R, Huffman LH, American Pain Society, American College of Physicians. Nonpharmacologic therapies for acute and chronic low back pain: a review of the evidence for an American Pain Society/ American College of Physicians clinical practice guideline. Ann Intern Med 2007; 147: 492–504.
13. Alemanno F, Houdayer E, Emedoli D et al. Efficiecy of virtual reality to reduce chronic low back pain: Proof-of- concept of a non-pharmacological approach on pain, quality of life, neuropsychological and functional outcome, Plos One 2019 May 23;14(5).
14. *Rodrigues LCL, Natour J, Surgical treatment for lumbar spinal stenosis: a single-blinded randomized controlled trial. Adv Rheumatol 2021 May 12;61(1):25.*
15. *Almeida VCPA, Felix HF, Navarro FAM et al. Prospectıve Controlled Study of Spınal Surgery Versus Physical Capacıty. Acta Ortop Bras 2023; Apr 17;31.*
16. *Yamamoto Y, KawakamiM, Minetama M et al. Psychological Predictors of Satisfaction after Lumbar Surgery for Lumbar Spinal Stenosis. Asian Spine J 2022; Apr:16(2):270-278.*
17. *K Silverplats, B Lind, B Zoeg, Health- related quality of life in patients with surgically treated lumbar disc herniation. Acta Orthopaedica 2011;82(2):198-203.*