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Research article

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Another perspective on lumber spinal stenosis treatment: Should exercise be added to pre-surgical treatment?

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Ethics Committee Approval
This study was approved by the Tekirdağ Namık Kemal University Ethics Committee (date: 06.02.2019 number: 2022.87.05.13).
All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.

Conflict of Interest
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Abstract

Background/Aim: Lumbar spinal stenosis (LSS) is a disease that affects the quality of life of elderly individuals. Most patients undergoing surgery for lumbar spinal stenosis try physical therapy before opting to undergo surgery. The effect of pre-surgical exercise treatment is unclear. This study aimed to examine the effect of pre-surgical exercise treatment on functionality, quality of life, and balance.

Methods: Patients between the ages of 40 and 70 who were scheduled for surgery based on a diagnosis of LSS were included in this cross-sectional study. The patients were randomly divided into two groups for which exercise therapy was added to the first group before the surgery, and the control group followed in the normal process. Visual Analogue Scale (VAS), Oswestry Disability Index (ODI), Beck Depression and Anxiety Inventory (BDI and BAI, respectively), Berg Balance Scale (BBS), static and dynamic balance measurements holding hands on and off on the balance device (SBHON, DBHON, DBHOFF) and the SF-36 quality of life scale tests were administered pre-operatively and eight weeks post-operatively, and the results were compared between the two groups that did and did not exercise before surgery.

Results: Post-operative SBHON values were found to be significantly lower in the exercise group compared to the other group ($P < 0.001$). While no differences between pre- and post-operative BBS, DBHON, and DBHOFF values in the non-exercising group were detected, a favorable significant difference in the exercising group was found (all $P < 0.001$).

Conclusion: The addition of pre-surgical exercise therapy to patients can lead to improvements in the success of surgery and contribute to the functionality of patients with LSS diagnosis.

Keywords: Balance, Disability, Exercise, Lumbar spinal stenosis

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Introduction

Lumbar spinal stenosis (LSS) affects the quality of life, especially in elderly patients [1]. Clinical findings include low back pain, paresthesia, and neurogenic claudication. Patients who are afraid of aggravating their symptoms do not want to walk, which negatively affects the quality of life [2].

Treatment is divided into two options: (1) surgical and (2) conservative. Decompression (with or without fusion) can be performed as a surgical treatment [3]. Conservative treatment options include physiotherapy, bracing, epidural steroid injection, medical treatment, and patient education [4]. Clear superiority of any one of these treatment methods over another one could not be determined [5]. The choice of treatment should be planned according to the patient's clinical condition, compliance with treatment, existing co-morbid conditions, and patient preference.

Although many studies in the literature comparing conservative and surgical treatment methods have been published, not enough studies evaluating the effect of adding exercise therapy before surgery are available [6]. In a study examining the effects of pre-surgical exercise, results were partially in favor of exercise; however, this issue has not yet been clarified. This study aimed to evaluate the effects of adding pre-surgical exercise therapy on the quality of life and functional parameters during the post-operative period in patients with an LSS diagnosis for whom surgical treatment was considered.

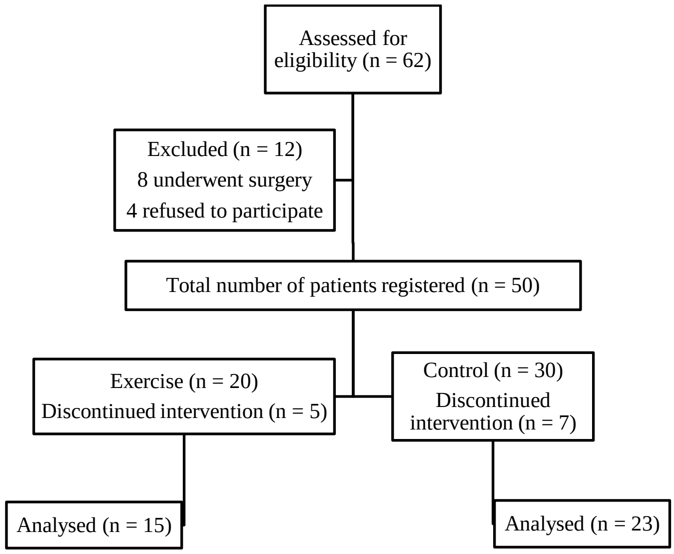
Materials and methods

Patients aged 40–70 years, who were scheduled for surgical treatment due to degenerative LSS and volunteered for the study were included in the study. Surgical indication criteria were determined as low back and/or radicular pain despite medical treatment, neurological claudication below 100 m with an antero–posterior diameter of 11.5 mm and a cross-sectional area of smaller than 1.45 cm² of spinal canal based on lumbar magnetic resonance imaging. Cases of non-degenerative LSS, those with cognitive impairment, chronic obstructive pulmonary disease, congestive heart failure, polyneuropathy, malignancy, and/or hypothyroidism, those with a history of antidepressant use, and those with advanced gonarthrosis, coxarthrosis, and/or a body mass index (BMI) greater than 30 kg/m^2 that would affect walking, stenosis more than two segments and/or scoliosis requiring osteotomy or correction during surgery were excluded from the study.

Approval for this prospective study was granted by the Namık Kemal University Ethics Committee (No: 2018.160.11.10). The research protocol was performed in accordance with the Declaration of Helsinki. Informed consent was obtained from all study subjects after the explanation of the nature of the study and possible consequences of the study.

BMI, age, and demographic characteristics were recorded for all patients and controls, and all subjects underwent a general physical examination by the same investigator. Power analysis was performed with the effect size (d) = 0.8, α = 0.05, power (p) = 0.8, N2/N1 = 1 using the G-power 3.0.10 program, and it was calculated that the groups should consist of at least 15 people. Sixty-two patients were evaluated, and 12 patients were excluded from the study. A total of 50 patients were included: (1) 20 patients in the exercise group and (2) 30 patients in the control group. Since five patients from the surgical group and seven patients from the control group could not complete the study, the study was completed with a total of 38 patients (15 exercise, 23 control). The flowchart is presented in figure 1.

Figure 1: Flowchart of the study



All patients were referred to the physical medicine and rehabilitation clinic prior to surgery for Berg Balance Scale scoring and measurement of dynamic balance scores by, Korebalance Premiere Balance Device, CA, USA, 2007 with static hands holding (SBHON), dynamic hands holding (DBHON), and dynamic hands free (DBHOFF) on a moving platform. The Oswestry Disability Index (ODI), which was previously validated and is reliable in Turkish, was used to determine their functional status [7]. In addition, the SF-36 questionnaire form, which is valid and reliable in Turkish, was completed by patients for quality of life assessment [8]. All patients signed visual analog scales (VAS) to evaluate the pain intensity before and after the exercise treatment.

VAS was evaluated using a 10-point graded scale for which 0 indicated absence of symptoms, and 10 indicated the worst symptoms. Valid and reliable Turkish versions of Beck Depression and Beck Anxiety Inventories (BDI and BAI, respectively) were evaluated before and after the treatment [9, 10].

The patients were then randomly divided into two groups using a simple random-number drawing procedure. Those who picked odd numbers from the bag were assigned to exercise group, whereas who picked even ones were assigned to the control group.

The first group was given a pre-surgical exercise program. Lumbar flexion exercises (three times 30 s single knee-to-chest, three times 30 s double chest-to-knee), trunk raises (ten times 6-second bouts) and bridging in the supine position, and four-point knee exercise twice daily were given to patients. Three times for 30 s stretching exercises were recommended for the hamstring muscles. Strengthening exercises for lower extremity muscles were recommended using 2–3 sets,10 repetitions, and 6 s contractions. In addition, each patient was advised to take painless walks for 15 to 30 min daily. Exercise training was given to the patients by the same therapist and visual, diagrams were provided to keep in their mind. The patients participated in this exercise program in the form of a home exercise program, and they were motivated by phone calls every week. The second group was the control group consisting of patients who were followed with a standard follow-up program.

The patients in the first group were admitted to surgical treatment 6–8 weeks after the onset of the exercise program, and the second group was promptly admitted to surgical treatment. Surgeries were performed by the same surgeon who had more than 10 years of professional experience. All patients underwent total laminectomy, bilateral foraminectomy, and rigid stabilization with a transpedicular screw via a posterior approach with preservation of the standard facet joints. All pre-operative evaluations were repeated at the eighth post-operative week.

Statistical analysis

The Statistical Package for Social Sciences (SPSS) Version 25.0 statistical software was used to analyze the data. A Shapiro–Wilk test was used to assess conformity of the data to the normal distribution. An independent sample t-test was used to examine independent (between-group) two-group normally distributed quantitative data, whereas the paired sample t-test was used to compare two dependent (within-group) quantitative variables. A value of $P < 0.05$ was accepted as the statistical significance threshold.

Results

Thirty-eight patients, including 15 in the exercise group and 23 in the control group, were included in the study. The exercise groups had 10 women and five men in the exercise group, and 17 women and six men in the control group. No significant difference between the demographic data of the patients was found. The results are summarized in Table 1.

Table 1: Demographic characteristics of the exercise and control group

	Exercise Mean (SD) (n = 15)	Control Mean (SD) (n = 23)	*P*-value
Age (years)	55.86 (7.79)	60.34 (8.14)	0.099
Sex	10 F (66.7%), 5 M (33.3%)	17 F, (73.1%) 6 M (26.1%)	0.648
BMI (kg/m^2)	26.83 (1.89)	27.40 (1.71)	0.358

BMI: Body Mass Index, M: mean, SD: standard deviation, n: number of samples

Prior to treatment, no significant difference between the VAS, BAI, BDI, Oswestry Disability Index scores, BBS, and measurements obtained from the balance device between the patient and control groups were found. In post-treatment evaluations, a difference was found between the two groups in SBHON values, but no statistically significant difference was observed between groups in terms of other parameters. The results are presented in Table 2.

Significant improvements in VAS pain, BAI, BDI, and Oswestry Disability Index scores pre- and post-treatment in both the exercise and the control group were noted. In terms of the balance parameters, a statistically significant difference was observed in the BBS in the exercise group, while this difference was not observed in the control group ($P < 0.001$ versus $P = 0.06$). In the measurements made using the balance device, a significant difference in both static and dynamic parameters in the exercise group was found (all $P < 0.001$).

In the control group, a statistically significant difference was found in dynamic and static measurements made with holding hands ($P < 0.001$ versus $P = 0.023$), while no significant difference was found in the hands-off dynamic measurement ($P = 0.153$). All results are summarized in Table 3.

Table 2: Comparison of pain, disability, and balance parameters of the groups before and after treatment.

	Before treatment			After treatment		
	Exercise Mean (SD) (n = 15)	Control Mean (SD) (n = 23)	*P*-value	Exercise Mean (SD) (n = 15)	Control Mean (SD) (n = 23)	*P*-value
VAS	7.13 (2.92)	6.91 (1.53)	0.791	4.06 (2.05)	2.95 (2.26)	0.128
ODI	45.73 (28.1)	53 (22.95)	0.411	32.46 (22.47)	28.26 (18.42)	0.551
BBS	47.13 (14.11)	43.30 (12.16)	0.396	50.73 (11.47)	45.13 (13.72)	0.183
BAI	14.86 (9.92)	16.6 (10.65)	0.611	10.46 (7.26)	7.30 (5.12)	0.157
BDI	12.53 (8.23)	13 (9.37)	0.873	7 (4.79)	8.34 (5.54)	0.432
SBHON	649.5 (147.2)	733.3 (165.03)	0.112	421.6 (120.8)	658.9 (206.7)	<0.001
DBHON	1054,6 (215.1)	984 (230.03)	0.343	833.13 (203.6)	897.9 (286.9)	0.421
DBHOFF	1627.2 (461)	1378.3 (355.2)	0.088	1249.4 (310.4)	1340.8 (369.8)	0.417
SF-36	44 (18.04)	42.17 (19.29)	0.769	66.00 (16.49)	56.95 (17.69)	0.118

VPS: Visual Analogue Score, ODI: Oswestry Disability Index, BBS: Berg Balance Scale, BAI: Beck Anxiety Inventory, BDI: Beck Depression Inventory, SBHON: Static Balance Hands-ON, DBHON: Dynamic Balance Hands-ON, DBHOFF: Dynamic Balance Hands-OFF, SF-36: Short-Form 36, M: mean, SD: standard deviation, n: number of samples

Table 3: Within group comparison of changes of the pain, disability, and balance parameters of the groups before and after treatment.

	Exercise (n = 15)			Control (n = 23)		
	BT Mean (SD)	AT Mean (SD)	*P*-value	BT Mean (SD)	AT Mean (SD)	*P*-value
VAS	7.13 (2.92)	4.06 (2.05)	<0.001	6.91 (1.53)	2.95 (2.26)	<0.001
ODI	45.73 (28.1)	32.46 (22.47)	<0.001	53 (22.95)	28.26 (18.42)	<0.001
BBS	47.13 (14.11)	50.73 (11.47)	0.001	43.3 (12.16)	45.13 (13.72)	0.060
BAI	14.86 (9.92)	10.46 (7.26)	<0.001	16.6 (10.65)	7.3 (5.12)	<0.001
BDI	12.53 (8.23)	7.00 (4.79)	0.009	13.00 (9.37)	8.34 (5.54)	0.017
SBHON	649.5 (147.2)	421.6 (120.89)	<0.001	733.3 (165.03)	658.9 (206.7)	<0.001
DBHON	1054,6 (215.1)	833.13 (203.6)	<0.001	984 (230.03)	897.9 (286.9)	0.023
DBHOFF	1627.2(461.02)	1249.4(310.42)	<0.001	1378.3 (355.2)	1340.8 (369.8)	0.153
SF-36	44 (18.04)	66 (16.49)	<0.001	42.17 (19.29)	56.9 (17.69)	<0.001

BT: Before Treatment, AT: After Treatment, VPS: Visual Analogue Score, ODI: Oswestry Disability Index, BBS: Berg Balance Scale, BAI: Beck Anxiety Inventory, BDI: Beck Depression Inventory, SBHON: Static Balance Hands-ON, DBHON: Dynamic Balance Hands-ON, DBHOFF: Dynamic Balance Hands-OFF, SF-36: Short-Form 36,M: mean, SD: standard deviation, n: number of samples

Discussion

The current study aimed to evaluate the effect of pre-surgical exercise therapy on the quality of life and functionality during the post-operative period in patients with a diagnosis of LSS. According to the results of our study, exercise therapy for patients in the pre-operative period, even for a short time, provides positive and significant contributions in the post-operative period. Our study makes an significant contribution to the literature in terms of describing that the balance parameters are also affected by LSS and revealing these results using objective balance measurements.

Limited data are available in the literature evaluating the effect of exercise therapy before LSS surgery. Conflicting results have also been reported in these limited studies . In a study by Nielsen et al. [11], it was shown that the pre-operative rehabilitation program improves patient outcome and shortens the length of hospital stay. However, in the Nielsen study, patients were treated with protein support before and after surgery and pain control in the early rehabilitation process, and exercise efficiency was not evaluated alone. The Nielson study also evaluated all patients who underwent spinal surgery, not only LSS patients. Likewise, in the meta-analysis conducted by Janssen et al. [12], a total of 15 studies were evaluated, and most of these studies focused only on cognitive behavioral therapy. According to the results of the Janssen meta-analysis, which had a very low–moderate quality of evidence, the authors stated that pre-rehabilitation (prehabilitation) does not contribute much to analgesic use, length of hospital stay, anxiety–depression, functionality, and/or quality of life. Marchand et al. [13] evaluated the effectiveness of prehabilitation in patients with elective LSS surgery. In that study, it was found that prehabilitation was partially effective for these patient, but this effect was found to be short-term and not been observed long-term. Similar results were found in our study, and it was shown that exercise therapy added before surgery had a positive effect on post-operative parameters in the short term, while long-term effects were not evaluated.

Similar to the other studies in the literature, our study was conducted with questionnaire forms for anxiety, depression, pain, and quality of life in addition to functional assessments, and unlike other studies, measurements obtained with a balance device and its associated objective data were also obtained. Balance disorder is a finding that frequently accompanies other parameters in LSS patients, and rates of up to 40% to 65% are reported in the literature [14, 15]. Effects on both static and dynamic balance parameters in patients have been described in which both static and dynamic balance parameters are affected in patients. Improvements in post-operative balance parameters were found in some studies [16, 17]. In our study, an increase in post-surgical balance parameters in both groups was found, but this effect was more significant in the exercise group. The dynamic balance parameter without holding hands was observed in the exercise group. Kinesiophobia, which occurs in patients who are afraid of falling and may develop after balance disorder, also impairs their quality of life, so exercise therapy for appropriate patients before surgery is very important in terms of functionality and quality of life.

Limitations

Several limitations in our study should be mentioned. The small number of patients is the first limitation. The predicted number of patients could not be included in the study due to coincidence with a period when elective surgeries could not be performed during the world wide coronavirus 2019 (COVID-19) pandemic. Post-operative evaluations of the patients were performed at the third month; however, whether exercise therapy was effective for a longer period of time was not evaluated. Due to staff limitations, patients were given a home exercise program in the exercise group, and patients did not exercise under the supervision of a physiotherapist. However, to increase the compliance of patients undergoing exercise therapy, they were asked to keep an exercise log book and were motivated by weekly phone calls. In this process, patients who were not properly exercising were excluded from the study. Many strengths of our work can be described. Although the number of patients is small, it is an important point that the surgeries were performed by a single physician. Besides tests and questionnaire forms used for pre- and post-surgical evaluation of patients, obtaining objective data using a balance device is another strength of the study.

Conclusion

In patients who were considered for surgical treatment due to a diagnosis of LSS, adding eligible exercise therapy (6–8 weeks) pre-operatively can both increase the success of the surgical treatment and contribute to the functionality of the patients.

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