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The effect of surgery on balance and physical performance in patients with low back pain

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Research Report

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Purpose: The purpose of this study was to examine the effect of surgery on balance and physical performance in patients with low back pain (LBP). **Material and methods:** Thirty-five patients operated for lumbar disc hernia (operated group: 13 women, 22 men), 30 patients with low back pain (LBP) (LBP group: 23 women, 7 men), and 34 healthy subjects (healthy group: 24 women, 10 men) were included in the study. Performance tests, including daily life activities such as lie/sit test, sit/stand test, bed /chair test, 30 m walking test were applied to the subjects. To assess balance Flamingo Balance Test was used with eyes opened and closed. The test time was 60 seconds for eyes opened, and 30 seconds for eyes closed. **Results:** The balance and performance measures were compared between the groups and significant differences were found ($p<0.05$). The results of balance and performance measurements were found lower than the other two groups (LBP, healthy subjects) in the operated group. **Conclusion:** The results showed that having had a surgery affects balance and performance negatively in LBP.

Keywords: Low back pain, Balance, Physical activity.

Bel ağrısı olan hastalarda cerrahinin denge ve fiziksel performans üzerine etkisi

Amaç: Bu çalışmanın amacı, bel ağrısı tanısı olan hastalarda cerrahinin denge ve fiziksel performans üzerine etkisini araştırmaktı. **Gereç ve yöntem:** Lumbar disk hernisi tanısı ile opere edilen 35 hasta (opere grup: 13 kadın, 22 erkek), bel ağrısı olan 30 hasta (BA) (BA grup: 23 kadın, 7 erkek) ve 34 sağlıklı olgu (sağlıklı grup: 24 kadın, 10 erkek) çalışmaya dahil edildi. Yatma/oturma testi, oturma/ayakta durma testi, yatak/sandalye testi, 30 m yürüme testi gibi günlük yaşam aktivitelerini içeren performans testleri olgulara uygulandı. Dengeyi değerlendirmek için flamingo denge testi gözler açık ve kapalı olarak kullanıldı. Test süresi 60 saniye gözler açık, 30 saniye gözler kapalıdır. **Sonuçlar:** Denge ve performans ölçümleri gruplar arasında karşılaştırıldı ve anlamlı değişiklikler bulundu ($p<0.05$). Opere grupta denge ve performans ölçümleri diğer iki gruptan (BA, sağlıklı olgular) daha düşük bulundu. **Tartışma:** Sonuçlar, bel ağrısında cerrahi geçirmenin denge ve performansı olumsuz etkilediğini gösterdi.

Anahtar kelimeler: Bel ağrısı, Denge, Fiziksel aktivite.

Low back pain (LBP) is a common, complex, costly, and controversial problem. Little is known about the causes of LBP, but poor neuromuscular control of trunk muscles has been identified as a plausible contributing factor.[1] Several studies have described motor control impairments, such as abnormal muscle recruitment and/ or activation levels, associated with LBP[2], however, it has yet to be demonstrated whether or not these impairments are the cause or simply the consequence of LBP.

Postural control may be affected in subjects with LBP. But the cause of this disturbance has not been known yet. Specifically, it is not clear whether changes in postural control are related to pain itself and to its stressful nature, so-called ''pain interference''. In humans, discharge from high-threshold nociceptive afferents interacts with spinal motor pathways as well as with primary somatosensory and motor cortex. These complex actions are likely to contribute to adaptive changes in postural control. In addition, proprioceptive impairment has been suspected as one of the possible causes for balance impairments in LBP.[3-9]

Traditionally, standard clinical assessments of LBP have focused on the degree of impairment in the lower back. The present trend is to complement measures with functionally based measures that address unresolved measurement issues on a battery of physical performance tasks that are examples of functionally based measures.[10]

The need for developing appropriate tools for measuring mobility and activities of daily living was recently characterized as a priority for research by an international task force on back pain. Timed tests of activities such as walking, the sit-to-stand task, and repeated trunk flexion have been examined in patients with back pain. It has been shown to have what we consider acceptable reliability, to be able to discriminate between people with and without back problems, and to be sensitive to change over time. The ability to discriminate between people with and without back pain also has been demonstrated in tests of performance.[11]

Evaluation of LBP is difficult due to the lack of suitable outcome measures available. The majority of LBP studies have focused on the trunk solely. Although the trunk is part of a system, the human body; in addition to specific trunk measures, performance of the entire body should be considered to guide treatment and measure progress during recovery.[12,13]

In the literature; there were lots of studies comparing muscle strength, muscle function, postural control, physical performance of healthy subjects and LBP patients or healthy subjects and operated patients. But we did not meet with any study about comparing operated and LBP patients.[14-19]

The aim of this study was to examine the effect of the surgery on balance and physical performance by means of sitting, standing and walking tests that were supposed to affect the balance as a determinant of the entire body performance in the patients with LBP.

Materials and methods

Subjects:

Thirty-five patients who applied to the neurosurgery department and had been operated with lumbar disc hernia diagnosis (without looking over the location and appearance the patients with single level disc hernia; operated group: 13 women, 22 men) and 30 patients with LBP who did not have an operation indication referred to the physiotherapy (LBP was determined by the presence of pain in the low back area observed on a pain diagram more than 6 weeks; LBP group: 23 women, 7 men), and 34 healthy subjects (healthy group: 24 women, 10 men) with no complaints of LBP were included in to the study between December 2005 to June 2006.

The subjects with diffused osteoporosis and findings such as spondylolisthesis, spinal stenosis infection, inflammatory process, or neoplasm, and with neurologic deficits were excluded from the study.

Surgical treatment:

All types of surgical techniques for lumbar disc herniation (i.e. discectomy, laminectomy, foraminatomy) were included. Surgical operation was performed by the same surgical team.

Evaluation:

Patients' socio-demographic characteristics such as age (year), body mass index (BMI)

(calculated by dividing weight into height (kg/m²), gender and type of occupation were recorded.

Physical performance measures: These physical performance tests were composed of physical capacity evaluation tasks representing physical abilities that are necessary to perform primary activities daily living.[11,17,18]

1. Lie/sit test: Starting from back lying position, the patients were asked to get their usual sitting position by turning aside swinging their feet.

2. Sit/stand test: While sitting on the bed with the feet on the floor, the patients were asked to stand up without supporting themselves with their arms.

3. Bed/chair test: While sitting on the bed with the feet on the floor, they were asked to stand up without using their arms and to sit on the chair next to the bed.

4. 30 m walking test: They were asked to walk a distance of 30 m as fast as they could.

The measurements were recorded with a chronometer as seconds. The higher scores showed the worse results in performance measurement.

Balance measurement: To apply Flamingo Balance Test; the patients stood on a single foot with eyes open and with eyes closed. The test time was 60 seconds for eyes opened, and 30 seconds for eyes closed. When the non-weight bearing foot touched the ground the test was finished.[20,21] The time was recorded with a chronometer as seconds. If the non-weight bearing foot did not touch the ground the test was completed in these periods. The test was done on dominant foot. All the patients were right dominance. The lower scores showed worse results in balance measurement.

Test procedures:

The measurements were repeated three times in physical and balance tests, and the average values were recorded. All measurements were carried out by using bed and chair at standard height, in the same place, at standard room temperature, and with the naked feet. The measurements of the operated patients were taken in the first postoperative month. The first postoperative month was routine control time for these patients. Operated and nonoperated LBP patients were evaluated on the day that they had been referred to the physiotherapy.

The study was conducted in accord with the Decleration of Helsinki. Required explanations were made to our patients and required approval was obtained from them for the evaluations and participation in the study.

Statistical analysis:

Demographic data were examined by descriptive analyses. Descriptive statistics including frequencies, means, and standard deviations were calculated for each of the groups.

In the comparison of age and BMI within the groups, the ANOVA (univariate analysis of variance test) test was applied, and in the comparison of gender differences the chi-square test was applied.

The ANOVA using the type of Bonferroni correction was applied for the comparison of balance and performance measurements in order to determine which group the significant difference resulted from ($p<0.05$).

The correlation between the age and BMI, and balance and performance tests were examined by the Pearson correlation test. Level of significance was set at $p<0.05$. The data were analyzed by using the statistical package for the social sciences, version 11.0.

Results

The demographic characteristics such as age, BMI, gender, and occupation type are shown in Table 1. No differences were found for age and BMI characteristics ($p>0.05$), but significant differences were found for gender ($p<0.05$) among the groups.

Statistically significant differences were found when balance and performance parameters were compared among groups ($p<0.05$) (Table 2).

The 60–second eyes opened balance test has been completed by six operated patients, 11 LBP patients and 20 healthy subjects. While none of the operated and LBP patients completed the 30 seconds eyes closed balance test, 6 healthy subjects completed the test.

Consequently, the differences in the balance and performance parameters among the groups were found to have resulted from the operated

group. When the groups were compared according to the gender, no statistically differences were observed in balance and performance measurements in all groups ($p>0.05$). Because all the groups were homogeneus in terms of age and BMI; we did not compare the balance and performance results of the groups according to age and BMI. But we examined the correlation between age, BMI and balance, performance measurements.

Significant and negative correlation was observed between age and balance with eyes opened in the operated group ($p<0.05$). On the other hand, significant and negative correlation was determined between BMI and balance with eyes closed in the non-operated group ($p<0.05$) (Table 3).

When the correlations between age, BMI and performance measurements were examined; there was not any correlation among the parameters in the operated group ($p>0.05$). There was a significant and positive correlation between age, BMI and lie-sit test, sit-stand test ($p<0.05$) while there was no any correlation between ages, BMI and bed-chair test ($p>0.05$). There was a positive correlation between age and 30 m walking test in the nonoperated group ($p<0.05$). In healthy group, there were only significant correlations between age and lie- sit test, and age and bed - chair test. ($p<0.05$) (Table 4).

Discussion

In this study, we evaluated the effect of surgery on the balance and physical performance. We found that having been an operation affects the balance and physical performance negatively.

Appropriate muscular control and movement sensation are of vital importance in preventing low back injury. Protection from injury requires an ability to anticipate events and to make suitable muscular responses. The appropriate proprioceptive information from trunk and lower limbs, as well as functional motor control of the trunk and lower limbs are essential in the maintenance of postural stability.[19]

In humans, the balance controlling system is believed to be phylogenetically old, and to operate relatively autonomously through the spinal and brainstem reflex networks. However, there is evidence that standing, rather than rely on mechano-reflex mechanisms, may require activity of higher order structures.[22,23]

LBP subjects' also demonstrated poorer postural control during unstable sitting tasks, especially with eyes closed as demonstrated by increased center of pressure (CP) excursions.[24] One possible explanation is that the LBP group may be stiffer than the no LBP group prior to the perturbation onset. The increased stiffness may be due to changes in the passive properties of the muscle and connective tissue associated with their chronic condition. It may also be due to an overall level of co-contraction of muscles around the joints due to fear of movement or anticipation of pain. Perception of increased risk for loss of equilibrium may be a contributing factor to the reduced speed/velocity with which people with LBP move during volitional tasks and may also play a role in reactive postural tasks.[25]

Impairments in postural control and lumbar movement perception have been observed previously in LBP patient, but not in operated patients. Also, the effect of surgery on postural control and lumbar proprioception in patients with disc herniation is a novel finding, lumbar proprioception and the control of paraspinal reflexes seemed to improve after discectomy, but the impaired postural control did not recover after surgery.[19]

When we looked at the literature; we saw that there were lots of studies comparing healthy subjects and LBP patients or healthy subjects and operated patients. But we did not meet any study about comparing operated and LBP patients in balance and physical performance**.**

Della Volpe et al. have demonstrated that, in LBP patients greater postural sway in anterior-posterior direction becomes manifest during quiet standing as compared to healthy subjects, when challenging conditions are met. This finding may suggest a decreased ability to detect small motions of the platform during dynamic stance in LPB patients.[26]

Table 1. Demographic characteristics of the patients.

	Operated Group (N=35) X (SD)	LBP Group (N=30) X (SD)	Healthy Group (N=34) X (SD)	
Age (years)	44.8 (9.03)	45.53 (13.60)	42.88 (12.22)	
Body mass index (kg/m^2)	26.14 (3.85)	26.62 (4.59)	24.51 (4.77)	
	n (%)	n (%)	n (%)	
Gender				
Female	13 (37.1)	23 (76.7)	24 (70.6)	*
Male	22 (62.9)	7 (23.3)	10 (29.4)	
Occupation				
Light work	22 (62.9)	16 (53.3)	13 (38.2)	
Medium strenuous work	10 (28.6)	13 (43.3)	18 (52.9)	
Heavy work	3 (8.6)	1 (3.3)	3 (8.8)	

* p<0.05 (chi-square test). LBP: Low back pain.

Table 2. Comparison of balance and performance among groups.

	Operated Group (N=35) X (SD)	LBP Group (N=30) X (SD)	Healthy Group (N=34) X (SD)	
Lie-sit test (sec)	9.81 (4.84)	4.23 (1.91)	1.82 (0.69)	*
Sit-stand test (sec)	4.07 (2.61)	2.30 (0.82)	1.17 (1.20)	*
Bed-chair test (sec)	9.21 (3.60)	3.39 (0.76)	1.86 (0.65)	*
30 m walking test (sec)	52.49 (20.52)	25.99 (4.28)	19.90 (2.20)	*
Balance				
Eyes opened (sec)	22.51 (20.67)	35.58 (24.06)	44.44 (20.87)	*
Eyes closed (sec)	3.96 (4.71)	7.15 (5.97)	12.03 (10.67)	*

* p<0.05. LBP: Low back pain.

Table 3. Correlation between age, BMI and balance.

	Age r (p)	BMI r (p)
Balance (eyes open)		
Operated Group	-.406 (.016) *	-.169 (.333)
LBP Group	-.162 (.392)	-.056 (.768)
Healthy Group	-.302 (.082)	-.063 (.722)
Balance (eyes closed)		
Operated Group	-.312 (.068)	-.196 (.259)
LBP Group	-.225 (.232)	-.411 (.024) *
Healthy Group	-.229 (.193)	.005 (.977)

* p<0.05. LBP: Low back pain. BMI: Body mass index.

Table 4. Correlation between age, BMI and performance.

	Age r (p)	BMI r (p)
Lie-sit test		
Operated Group	.160 (.358)	.130 (.457)
LBP Group	.541 (.002) **	.510 (.004) **
Healthy Group	.500 (.003) **	.205 (.246)
Sit-stand test		
Operated Group	.241 (.164)	.113 (.518)
LBP Group	.493 (.006) **	.377 (.040) *
Healthy Group	-.215 (.223)	.007 (.970)
Bed-chair test		
Operated Group	.153 (.380)	.162 (.352)
LBP Group	.352 (.056)	.286 (.126)
Healthy Group	.462 (.006) **	.182 (.302)
30 m walking test		
Operated Group	.183 (.294)	.197 (.256)
LBP Group	.728 (.000) **	.443 (.014) *
Healthy Group	.307 (.077)	.180 (.307)

* p<0.05, **p<0.01.

In the study of Nies and Sinnott, twenty-five outpatients with LBP demonstrated greater postural sway and were more likely to fail in the one-footed balance task than 20 subjects without LBP.[6]

The question that was raised as to whether decreased motor skill, coordination, or postural control could be a risk factor or a cause of musculoskeletal disorders, brought about the need to research into the position of patients having undergone disc hernia operation. Therefore we wanted to describe the effects of having been an operation on the postural control and the performance by including the operated and non-operated patients with LBP in the study.

In the studies about balance and physical performance; the effects of demographic and anthropometric characteristics such as age, gender and BMI have been investigated. In our study; the groups were found homogeneous according to age and BMI. The significant differences were found in gender only.

When the balance and physical performance measurements of the groups were compared according to the gender; no significant differences were found. It has been examined the correlation between balance, physical performance and the homogeneous parameters as age and BMI.

Although the performance tests inform repetitive activities such as repetitive sitting - standing from a chair and repetitive trunk flexion; we carried out performance tests that were supposed to affect the balance resulting from simple daily living activities. The performance measurements of the patients who were anxious of the recurrence of the sickness and fear of activity due to pain in the early period; therefore, we did not apply the exact performance test batteries mentioned in the researches. We have assembled the tests related to daily life activities that do not result in pain, force the body to bend to the front or exert it.

A simple physical performance test, in our view, may not be sufficient to characterize physical functioning for all individuals with back problems. Although some activities cause pain in some

people, they relieve pain in others. People can be considered more disabled if performance is limited in several activities rather than in one activity.[27] This viewpoint is consistent with the findings of Thomas et al. and Waddell et al.[28,29] They showed that the sum of the scores of several physical tests could be better to discriminate between people with and without back pain than the use of separate tests. Provided that the tests measure a common construct of physical performance, the sum of the scores of several tests might offer a more comprehensive measure of trunk mobility than a score of a single test.

The maintenance and control of balance, whether under static or dynamic conditions, is an essential requirement for physical and daily activities.[9] In the Flamingo balance test that we applied in our study; the 60 second eyes opened balance test has been completed by operated patients as 17.1% and 36.7% by LBP patients. None of the operated and LBP patients completed the 30 seconds eyes closed balance test. The balance test scores of the operated patients were the worst in all groups.

According to the results of this research the surgery affected the balance and performance of the patients. Recurrence of the sickness and activity fear due to pain after the operation affected the balance and performance negatively. Fear and avoidance behavior that may initially reduce nociception in the acute phase of pain can have a negative effect on physical and psychological well being in chronic pain patients.[30] The fact that we had applied the test in the postoperative early period was considered to be another reason. Because the postoperative first month was routine control time of the patients we had to do measurements on this date.

Limitations of the Study

Performance and balance measurements of the operated patients were not carried out in the preoperative period. The pain and general health conditions of the patients in the preoperative period were not taken into consideration during the process of performance and balance measurements. Obtaining the measurements had been taken pre and post operatively would have provided more effective results. The cognition and depression levels of the patients related to the disease especially affected the performance. Yet, these levels could not be assessed in the research.

Conclusion

In this study, the differences determined in the performance and balance measurements obtained in the early period were attributed to the operated group. The reason of the negative effect of the performance and balance measurements in the operated group may be due to the fear from the activity, recurrence of the sickness and pain. Consequently, operated patients appear to be substantially deconditioned as compared to LBP and healthy volunteers.

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