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Effectiveness of Physical Therapy and Rehabilitation Programs Starting Immediately After Lumbar Disc Surgery

Lomber Disk Cerrahisi Sonrası Erken Dönem Fizik Tedavi ve Rehabilitasyon Programının Etkinliği

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ABSTRACT

AIM: The aim of this randomized study was to compare exercise program to control group regarding pain, back disability, behavioural outcomes, global health measures and back mobility who underwent microdiscectomy operation.

MATERIAL and METHODS: Thirty patients who underwent lumbar microdiscectomy were randomized into exercıse and control groups. After surgery, patients in the exercıse group undertook a 12-week home based exercise program, started immediately postsurgery and concentrated on improving strength and endurance of the back, abdominal muscles, lower extremities and mobility of the spine and hips. Outcome measures were: Oswestry Disability Index (ODI), Beck Depression scale, lumbar schober, Visual Analogue Scale (VAS), return to work (return-to-work status), generic functional status (SF-36).

RESULTS: Treatment compliance was high in both groups. Surgery improved pain, disability, general health status, lumbar mobility and behavioural status. After the exercise program, the exercise group showed further improvements in these measures at 12 week after surgery.

CONCLUSION: A 12-week postoperative exercise program starting immediately after surgery can improve pain, disability, and spinal function in patients who have undergone microdiscectomy.

KEYWORDS: Exercise therapy, Lumbosacral radicular syndrome, Microdiscectomy

ÖZ

AMAÇ: Çalışma, mikrodiskektomi ameliyatı sonrası egzersiz verilen grup ile verilmeyen kontrol grubunun ağrı, disabilite, duygu durumu, genel sağlık durumu ve bel mobilitesinin karşılaştırmasını amaçlamaktadır.

YÖNTEM ve GEREÇLER: 30 hasta çalışmaya alındı. Egzersiz grubuna ameliyat sonrası erken dönemde başlanılan, 12 hafta süren, ev tabanlı, bel, bacak, abdominal kasları kuvvetlendirici, enduransı arttırıcı ve bel mobilizasyonu artıran egzersiz tedavisi verildi. Ölçüm sonuçlarımız: Oswestry Disability Indeksi (ODI), Beck Depresyon Skalası, Lomber Schober, Visual Analogue Scale (VAS), işe dönüş zamanı, genel fonksiyonel durum (SF-36).

BULGULAR: Her iki grupta da tedaviye iyi yanıt alındı. Cerrahi girişim ile ağrı, disablite, genel sağlık durumu, duygu durum ve bel mobilitesinde iyileşme gözlemlendi. Egzersiz programından sonra, egzersiz grubu, kontrol grubuna kıyasla 12 hafta sonra ağrı, disabilte ve genel sağlık durumunda anlamlı iyileşme gösterdi.

SONUÇ: Operasyon sonrası erken dönemde başlanılan 12 haftalık egzersiz tedavisi, mikrodiskektomi geçiren hastalarda ağrının, disabiltenin azalması ve genel sağlık durumunun iyileşmesinde etkili olabilir.

ANAHTAR SÖZCÜKLER: Egzersiz tedavisi, Lumbosakral radiküler sendrom, Mikrodiskektomi

INTRODUCTION

Lumbar radicular syndrome is characterized by low back pain, leg pain and/or neurological deficits due to compression of one or more nerve roots as a result of lumbar or sacral intervertebral disc herniation (35). The development of low back and leg pain due to lumbar disc herniation is an important public health problem owing to its prevalence and health-care expenditure (4, 40).

Conservative and surgical methods are used for the treatment of lumbar disc herniation (36). There are different opinions and approaches for lumbar disc hernia surgery; lumbar microdiscectomy, a minimally invasive intervention,

is a surgical technique that is proven effective and hence recommended (3). Microdiscectomy is more successful than open surgery (1, 3, 32, 34). However, it has been reported that complete recovery was not obtained and complaints continued in 5%–20% of patients due to disc herniation (3, 15, 22, 31).

The reason for continued pain or complaints after the surgery is not fully elucidated. Previous studies report that surgical selection criteria, surgical technique and post-operative rehabilitation directly affect outcomes (6, 16, 19, 20, 24, 38). Pain may continue because of muscular atrophy, developing secondary to longstanding inactivity (5, 21). When atrophied muscles weaken, the load on intervertebral discs and surrounding ligaments increases (11). In addition, a reflex inhibition mechanism develops along with inactivity (39). Muscle weakness may start a vicious cycle. Abnormal use of other muscles may also lead to pain. Postural changes may be particularly observed in unilateral disc herniations. Minor postural changes may lead to significant changes in the intervertebral disc load (8,12) and zygapophysial joints (6). It has also been shown that long-term root compression and loss of labour have negative effects on surgical outcomes (8, 13, 17, 18).

Previous studies found that exercise programs implemented after lumbar disc herniation surgery effectively reduce post-operative pain and disability, improve general health status, facilitate early return to daily activities and improve the quality of life. Different types of exercises were applied in different combinations and intensities; however, there is no single treatment protocol on which a consensus has been reached about the type, intensity or when to start exercise as well as whether home- or clinic-based exercise should be applied (2, 6, 14, 19, 20, 24, 27, 37, 38). The current study aimed to determine whether an early home-based exercise program would provide additional benefit to patients who underwent microdiscectomy for lumbar disc herniation.

MATERIAL and METHODS

The present clinical study was carried out by the Department of Physical Medicine and Rehabilitation, Osmangazi University with patients who underwent microdiscectomy for the first time in the Department of Neurosurgery after Eskisehir Osmangazi University Ethics Comittee approval (02.11.2011, No: 3) had been obtained.

Inclusion criteria were as follows:

1. Adult patients aged 18–60 years
2. Patients with magnetic resonance imaging-verified diagnosis of unilateral lumbar disc herniation

Exclusion criteria were as follows:

1. Sequestration of herniated disc
2. History of previous spinal and spinal cord diseases
3. History of previous spinal surgery
4. Coexistence of other lumbar degenerative diseases such as lumbar spondylosis, spondylolisthesis or lumbar spinal stenosis
5. History of cardiovascular, pulmonary, metabolic, neurologic or psychiatric diseases (uncontrolled hypertension or diabetes mellitus, chronic obstructive pulmonary disease, asthma, coronary artery disease, dementia, Parkinson's disease, etc.) and an active infection that could interfere with exercise and surgical therapy
6. Presence of additional post-operative neurological deficits, infection or pathology, requiring active care of the surgical wound

The current study was a prospective, randomized, controlled, single-blind study. Written informed consent was obtained from all participants. Thirty patients were included in the study. Patients were allocated into two groups, by the sealed envelope method, consisting of a treatment (group I) and a control (group II) group, each with 15 participants.

Patients in each group were raised by the surgeon on post-operative day 1 and wound care was administered. They were then given instructions regarding lying, standing, sitting and walking by a physical therapy and rehabilitation specialist. No additional exercises were given to the control group. The treatment group was given a home-based exercise program starting on post-operative day 1. The home-based exercise program included pelvic tilt and abdominal exercises and isometric quadriceps strengthening and isometric thigh extensor strengthening exercises on post-operative day 1. Back stretching exercises, straight leg raise test, harmstring stretching, hip flexor stretching and isotonic quadriceps strengthening exercises were added after the first week. Passive and active low back extension exercises, low back muscle strengthening and mobilization exercises and isotonic hip extensor strengthening exercises were added after the sixth week. Two sets of each exercise were completed daily, three days a week, for 12 weeks. Exercises given in the first week were 10 repetitions and exercises given after the first week were started at 5 repetitions and increased as much as possible until a maximum of 10 repetitions were achieved. Exercises were demonstrated to the patients along with instructions.

All assessments were done before and 12 weeks after the surgery by a physical therapy and rehabilitation specialist blinded to the study. Patients were evaluated using the Oswestry Low Back Pain Disability Questionnaire, Visual Analogue Scale (VAS), Beck Depression Inventory scale, and the Short Form (SF) 36 (1, 7).

Assessment Parameters

The *Oswestry Low Back Pain Disability Questionnaire* is composed of 10 questions that evaluate pain, self care, heavy lifting, walking, sitting, standing, sleeping, social life and travelling, scoring them between 0 and 5. The highest possible score is 50 and results are given as a percentage (score/total

score (50) × 100 = %). The Turkish validity and reliability have been shown (41).

The *VAS* was used to measure severity of low back and/or leg pain. Participants were asked to score the pain they felt on a 10-cm scale using an 'X' sign. On this scale, '0' indicated no pain and '10' indicated the most severe pain. The numerical value was recorded as the pain severity of the patient. The Turkish reliability and validity of this scale have been shown.

The *Beck Depression Inventory Scale* is a test composed of 21 questions evaluating the severity and presence of depression. The questions investigate somatic, cognitive and affective symptoms. Each item is composed of 4 different statements, arranged in ascending order, regarding a specific symptom of depression. Statements are scored between 0 and 3. Higher scores indicate severe depression and the highest possible score is 63. The Turkish reliability and validity have been shown (23).

SF-36 is a self-assessment scale consisting of 36 questions and composed of 8 sub-scales. The scale is composed of items investigating physical functioning, pain, role limitations, vitality, social functioning, mental health and general health status. Each scale is scored between 0 and 100; '0' indicates the poorest quality of life and '100' the best quality of life. Scores are calculated individually for each scale. The Turkish reliability and validity have been shown (30).

All patients were questioned about the duration of time it took to resume work at the end of the study, whether they received analgesic drugs or not, and satisfaction from the treatments. It was recommended that the patients contact either the surgeon or us as soon as possible in case of pain or other complaints. Duration and dose of the required analgesic during this period was evaluated separately at the end of the study.

Resuming work: Participants were asked when they resumed work and daily activities. Time taken to return to daily activities was considered for housewives and retired participants. Assessment was done 12 weeks after the surgery.

Patient satisfaction: The patients' satisfaction from the treatment was recorded.

Statistical analysis: A statistical package program was used for data analysis. The Kolmogorov-Smirnov test was used for normality distribution along with descriptive statistics (frequency, percent, mean and standard deviation). Pearson's chi-square test was used for comparing qualitative data. Inter-group comparison of qualitative data was done using a Mann–Whitney U-test. The Wilcoxon test was used for in-group comparisons. Results were evaluated using a 95% CI, $p < 0.05$ significance level and $p < 0.01$ high significance level.

RESULTS

A statistically significant difference was not observed between the two groups, in terms of follow-up parameters ($p>0.05$) (Table I, II, III). When compared with the pre-operative period, a statistically significant improvement was found in the SF-36 vitality and SF-36 emotional role restriction in the treatment group and SF-36 vitality in the control group ($p<0.05$) at 12 weeks and in both groups in all the other parameters ($p<0.01$).

When the groups were compared at week 12, a statistically significant difference was found in the VAS ($p<0.05$), Oswestry Low Back Pain Disability Questionnaire ($p<0.01$) and physical functioning of the SF-36, including body pain ($p<0.05$) and social functioning ($p<0.05$) sub-parameters. A statistically significant difference was not observed between the control and treatment group in terms of return to normal life and patient satisfaction ($p>0.05$) (Table IV, V). Results of the assesments are shown in Table VI.

Table I: Demographic Characteristics of the Patients

Characteristic	Treatment group (n=15)	Control group (n=15)	p
Age, x±sd, year	48.533±11.951	44.133±8.887	0.262
Gender, n (%)			
Female	9 (%60)	8 (%53.3)	
Male	6 (%40)	7 (%46.7)	0.713
BMI, x±sd, kg/m^2	25.487±2.695	25.833±3.502	0.763
Occupation, n (%)			
Working	8 (%53.3)	7 (%46.7)	
Housewife	5 (%33.3)	6 (%40.0)	
Retired	2 (%13.3)	2 (%13.3)	0.924
Loss of working day, n (%)	10 (%66.7)	8 (%53.3)	0.456

Table II: Clinical Characteristics of the Patients

Characteristics	Treatment group (n=15) (%)	Control group (n=15) (%)	p
Preoperative treatment, n (%)			
Medical	14 (93.3%)	15 (100.0%)	0.500
Medical and Physical therapies	9 (60.0%)	8 (53.3%)	0.500
Pain duration, n (%)			
< 6 months	6 (40.0%)	10 (66.7%)	0.143
> 6 months	9 (60.0%)	5 (33.3%)	
Leg pain,n (%)			
Right side	8 (53.3%)	9 (60.0%)	0.713
Left side	7 (46.7%)	6 (40.0%)	
Neurological assessment n(%)			
Laseque	7 (46.7%)	10 (66.7%)	0.269
Motor dysfunction	9 (60.0%)	5 (33.3%)	0.143
Sensory deficit	8 (53.3%)	8 (53.3%)	0.999
Loss of deep tendon reflex	0 (0.0%)	4 (26.7%)	0.050
MRI, n(%)			
L4-5	10 (66.7%)	6 (40.0%)	0.143
L5-S1	5 (33.3%)	9 (60.0%)	
Operation time x±SD (mnt)	89.333±19.353	82.667±30.111	0.478

Table III: Preoperative Measurement Results

Parameter	Control		Treatment		p
	Mean	SD	Mean	SD	
Lumbar Schober	5.040	1.117	4.740	1.071	0.507
Beck depression	11.400	6.770	11.533	6.424	0.835
ODI	74.133	17.590	70.800	14.339	0.176
VAS	8.267	1.033	8.667	0.816	0.263
SF-36 PF	19.667	25.737	22.333	22.746	0.475
SF-36 RP	3.333	8.797	8.333	18.094	0.543
SF-36 BP	17.000	17.513	20.333	16.872	0.479
SF-36 GH	38.600	21.101	35.533	26.862	0.405
SF-36 VT	50.667	16.994	50.333	14.201	0.900
SF-36 SF	32.500	22.559	25.833	16.682	0.474
SF-36 RE	31.113	46.236	44.513	46.614	0.376
SF-36 GH	53.600	18.931	52.533	13.679	0.983

***VAS:** visual analogue scale, **ODI:** oswestry disability index.*

Table IV: Patient Satisfaction

		Control		Treatment		p
		n	%	n	%	
Satisfaction	Excellent	10	66.7	13	86.7	0.195
	Good	5	33.3	2	13.3	

Table V: Terms of Returning to Normal Life

		Control		Treatment		p
		n	%	n	%	
Returning to normal life	End of 6th week	10	66.7	12	80.0	0.409
	Between the 6th and 12th weeks	5	33.3	3	20.0	

Table VI: All Results of Assessments

Parameter		Pre-op (SD)	Postop 6 weeks (SD)	Postop 12 weeks (SD)
VAS	Control	8.267 (1.033)	1.333 (0.915)	1.400 (0.828)
	Treatment	8.667 (0.816)	1.067 (0.884)	0.667 (0.816)
	p	0.263	0.826	0.024*
ODI	Control	74.133 (17.590)	25.200 (11.827)	17.333 (8.024)
	Treatment	70.800 (14.339)	14.800 (10.387)	4.667 (4.938)
	p	0.176	0.008**	0.000**
Beck Depression Scale	Control	11.400 (6.770)	6.067 (4.743)	5.733 (5.257)
	Treatment	11.533 (6.424)	6.133 (5.235)	4.667 (5.394)
	p	0.835	0.901	0.465
SF-36 PF	Control	19.667 (25.737)	58.667 (24.602)	71.00 (24.647)
	Treatment	22.333 (22.746)	78.00 (13.066)	92.333 (6.779)
	p	0.475	0.017*	0.007**
SF-36 RP	Control	3.333 (8.797)	51.667 (33.363)	85.00 (31.053)
	Treatment	8.333 (18.094)	45.00 (40.311)	86.667 (29.681)
	p	0.543	0.538	0.737
SF-36 BP	Control	17.000 (17.513)	63.667 (20.145)	72.800 (17.264)
	Treatment	20.333 (16.872)	71.733 (17.850)	89.200 (15.209)
	p	0.479	0.249	0.011**
SF-36 GH	Control	38.600 (21.101)	58.267 (13.895)	62.267 (15.285)
	Treatment	35.533 (26.862)	64.533 (15.417)	72.200 (13.728)
	p	0.405	0.225	0.08
SF-36 VT	Control	50.667 (16.994)	64.333 (15.337)	66.000 (15.376)
	Treatment	50.533 (14.201)	68.733 (11.598)	71.000 (11.526)
	p	0.9	0.644	0.389
SF-36 SF	Control	32.500 (22.559)	65.000 (15.089)	72.500 (20.702)
	Treatment	25.833 (16.682)	73.333 (16.947)	87.500 (15.670)
	p	0.474	1.177	0.028*
SF-36 RE	Control	31.113 (46.236)	75.560 (36.660)	84.447 (30.517)
	Treatment	44.513 (46.614)	77.773 (34.893)	91.113 (26.625)
	p	0.376	0.791	0.389
SF-36 MH	Control	53.600 (18.931)	68.800 (11.924)	71.733 (15.673)
	Treatment	52.533 (13.679)	69.867 (13.845)	70.133 (13.511)
	p	0.983	0.77	0.558

**p<0,05, **p<0,01*

VAS: *visual analogue scale,* ***ODI:*** *oswestry disability index.*

DISCUSSION

In the current study, an improvement was found in the control and treatment groups as regards all assessment parameters. In the treatment group, improvement was more significant in the VAS, Oswestry Disability Index and SF-36. 'Excellent' patient satisfaction was reported in 80% of the treatment group and 66.7% of the control group. The findings indicate the positive effect of exercise on pain and the Oswestry Disability Index positively affect quality of life.

Previous studies have reported the positive effects of exercise on pain and disability after microdiscectomy (8, 13, 25, 29, 33, 42). However, the type, intensity, initiation time and last measured parameters of the exercises differ. Exercise categories such as low back, hip and lower extremity strengthening and back flexibility exercises, aerobics, neural mobilization and stretching, McKenzie & Williams exercises and behavioural exercises have been used in different combinations and intensities (33). Different opinions exist about when to begin the exercises. Previous studies have started exercise at post-operative week 4 or 6 and this seemed to positively affect healing after microdiscectomy (8, 13, 29). Kjellby-Wendth et al. suggested that exercise initiated on post-operative day 1 is clinically more effective (30).

The current study applied an early exercise program beginning on post-operative day 1. The intensity of treatment was consistent with patient tolerance and gradually increased with time. The control group was given no exercises in order to evaluate the effectiveness of the exercise. Obtaining a more significant improvement of pain, disability, and quality of life indicates that early exercise treatment could affect surgical outcomes positively.

Exercise therapies are implemented at an institution or as a home-based program. In controlled studies comparing clinic-based/intensive exercise and home-based exercise, it was shown that clinic-based/intensive exercise therapy is more effective than home-based exercise; however, home-based exercise was more effective than the control in terms of pain, disability and functionality (27, 33). Johannsen et al. compared home-based exercise and clinic-based exercise therapy. While no change occurred in the Oswestry Disability Index, a reduction in low back pain and an increase in quality of life were observed among the subjects who were given home-based exercises (26).

In the current study, patients were given home-based exercises, after considering the time and money required for going to an institution. The study also aimed to reduce the positive and/or negative psychosocial effect of hospital stay or hospitalization by applying a home-based exercise program.

Improvements were observed in the VAS, Oswestry Disability Index and SF-36 as well as the Beck Depression Inventory Scale. Similarly, previous studies reported that the Beck Depression Inventory Scale scores decrease as back pain decreases (26, 28). The psychometric value of the Beck Depression Inventory scale is quite high, and it is routinely recommended before and after lumbar disc operations together with clinical and radiological evaluation (26, 28). However, we did not detect a difference between the groups; this could be interpreted as exercise therapy as applied in the present study does not have a psychological effect.

The success of the therapy was also determined by evaluating the time it took to resume work. The ratio of those resuming work was reported as 70%–80% at the end of week 12 after lumbar disc surgery (10). Rehabilitation therapy applied after lumbar disc surgery was shown to increase the ratio of those resuming work (9). In the current study, all patients resumed work within 12 weeks in the follow-up period.

Severe pain observed in the early post-operative period is due to failure of the operation. Exercise therapy cannot be applied under these conditions. In the current study, significant reduction in the severity of pain positively affected the applicability of the exercise program.

This study has some limitations: the small number of subjects and a follow-up period of only 3 months. Additional problems such as radiological or clinical instability may develop in the long-term and lead to new clinical findings, particularly in patients who undergo spinal surgery. We could not find long-term studies investigating these parameters. Therefore, we limited the follow-up period to 12 weeks for evaluating the effectiveness of the exercise therapy. We consider that clinical and radiological assessments must also be done in long-term follow-ups with patients when evaluating the effectiveness of exercise therapy after microdiscectomy.

Results of previous studies investigating the effectiveness of exercise therapy after lumbar discectomy may be discussed with different interpretations. Diversity, intensity, when to begin exercise, duration of therapy and last measured parameters vary among different studies. Although the exercises are different, it is controversial to discuss them together as they were initiated only in the early period. Similarly, in the presence of different exercise programs and measurement methods, it is controversial to discuss whether exercise should be home- or clinic-based. We believe that meta-analysis and further studies that evaluate different results and where variabilities are minimized are required.

The exercises applied in the current study are easy to understand and perform and the follow-up parameters are valid internationally. Therefore, we believe that multi-centre studies with a similar protocol that include more patients and discuss the duration, intensity and exercise site are needed.

CONCLUSION

Our results show that early exercise therapy effectively reduces pain and disability and improves the quality of life in patients who undergo surgery for lumbar disc herniation. Therefore, we believe that a rehabilitation program applied after surgery would further improve the quality of life gained through surgery alone.

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