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ORIGINAL ARTICLE

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Functional results and the risk factors of reoperations after lumbar disc surgery

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Abstract Factors such as driving motor vehicles, sedentary occupations, vibration, smoking, previous full-term pregnancies, physical inactivity, increased body mass index (BMI), and a tall stature are associated with symptomatic disc herniations. Fitness and strength is postulated to protect an individual from disc rupture. The objective of our study was to determine the pain levels and differences of functional and economic situations of patients who had undergone one or more than one operation due to lumbar disc herniation and to put forward the effect of risk factors that may be potential, especially from the aspect of undergoing reoperation. Patients who had undergone one ($n = 46$) or more than one operation ($n = 34$) due to lumbar disc herniation were included in the study. It was a prospective study with evaluation on the day the patients were discharged and at second and sixth months after lumbar disc operation. The Oswestry Disability Index (ODI) was used in determining the functional disability associated with back pain; the Prolo Functional Economic Rating Scale (Prolo scale) was used in determining the effect of back pain on functional and economic situations. In the ODI measurements made in the postoperative second and sixth months, significant differences appeared in favor of patients who had undergone one operation ($p < 0.05$). According to the Prolo scale, it was found that the economic situation was better in the sixth month and the functional situation was better in the second and sixth months in patients having undergone one operation ($p < 0.05$). The logistic regression analysis demonstrated that the lack of regular physical exercise was a significant predictor for reoperation (OR, 4.595; CI, 1.38–15.28), whereas gender, age, BMI, occupation, or smoking did not indicate so much significance as regular exercise.

Keywords Lumbar disc surgery · Reoperations · Risk factors · Exercise

Introduction

The expression ''disc herniation'' is used as a collective term to describe a process with rupture of annulus fibers and subsequent displacement of the central mass of the disc in the intervertebral space common to the dorsal or laterodorsal aspect of the disc. Dorsal protrusion may be visualized as a bulging disc, or if the outer fibers of annulus are penetrated, as an extruded disc [37].

Progression of disc degeneration was related to the extent of disc herniation at baseline. Finding supports the hypothesis that disc herniation leads to an acceleration of disc degeneration [25]. Lack of exercise and evening or night work causing further exertion were

additional independent predictors for a deterioration of disc degeneration [9].

It is generally accepted that the etiology of disc degeneration of the lumbar spine is multifactorial and related to a variety of factors such as occupational and social environment as well as lifestyle factors and other individual characteristics [1, 16, 30].

The success rate of lumbar disc surgery varies from 60 to 90% [2, 18, 21, 27, 28].There are differences among studies with regard to inclusion criteria for surgery and in the way success was defined, which may account for the wide range in success rates. These figures show that in 10–40% of patients, results of surgical operations are unsatisfactory and patients still have symptoms. These persisting symptoms mainly consist of pain, motor deficits, and a decreased functional status. In 2–19% of patients who have undergone a first-time disc surgery, a recurrent herniated lumbar disc occurs and, in 74% of cases, it occurs within 6 months after the patient's first operation [4, 33]. If, despite the operation, patients still suffer from persisting symptoms, further treatment is often recommended (e.g., physiotherapy, rehabilitation programs) [5, 17].

Treatment programs started immediately after surgery. The outcome of surgical treatment among patients with lumbar disc hernia depends on postoperative regimes offered [6]. A rehabilitation program of intensive exercises despite occurrence of back pain as a limiting factor appears to increase patient behavioral support, resulting in improvement in work capacity and patient's self-related disability levels. Postoperative rehabilitation should include intensive back training, which has been shown to be of great value in behavioral support and restoration of functional deficits. This has resulted in increased work capacities for disc-operated patients [20, 26].

The objective of our study was to determine the disability levels and return-to-work differences of functional and economic situations of patients who had undergone one or more than one operation due to lumbar disc herniation and the effect of potential risk factors, especially with regard to undergoing reoperation.

Material and methods

Participants

Patients with severe chronic low back pain (CLBP) that had persisted at least 2 years were eligible for this prospective study or those with surgical indications. Patients who had one or more than one operation due to lumbar disc herniation were compared: 100 patients who were followed up at the University Hospital neurosurgery department during the period 1997–2002 were included. Twenty of those patients were excluded because of not attending controls regularly. Details of patient characteristics and interventions have been reported separately [12, 14].

Patients were eligible for the study according to the following inclusion criteria:

- Patients aged 25–50 of either with severe CLBP
- Back pain duration of at least 2 years
- Back pain more pronounced than leg pain and no signs of root compression
- Treating surgeon should interpret the pain as originating from $L_{3–4}$, $L_{4–5}$, L_5-S_1 using the patient's history, physical examination, and radiographic signs
- Symptoms or neuromuscular dysfunction elicited by lumbar disc herniation in patients not responding to nonsurgical treatment
- Patient must have been on sick leave (or have had equivalent disability) for a least 1 year, and one or more surgical treatment efforts should have been unsuccessful
- Degenerative changes at $L_{3–4}$, $L_{4–5}$ and/or L_5-S_1 (spondylosis) on plain radiographs and/or computed tomographic (CT) scan, and/or magnetic resonance imaging (MRI). The presence of a herniated disc was allowed in the absence of clinical sign of nerve root compression

Patients were ruled ineligible for the study according to the following exclusion criteria:

- Obvious ongoing psychiatric illness
- Having undergone more than four disc herniation operations
- Specific radiological finding such as spondylolisthesis, new or old fracture, infection, inflammatory process, or neoplasm
- Obvious painful and disabling arthritic hip joints as well as clinical and radiological sign of spinal stenosis
- Having undergone microdiscectomy and endoscopic surgery
- Not doing regular exercise or coming to controls regularly

The study was approved by the Ethical Committee at Dokuz Eylül University.

Surgical treatment

All types of surgical techniques for lumbar disc herniation (e.g., standard discectomy, laminectomy, foraminotomy) were included. Surgical operation was made by the same surgeon.

Study population and design

Of the 80 patients, 34 who had undergone more than one operation (two, three, or four times) formed group 1

and 46 who had undergone only one operation formed group 2. Patients' sociodemographic characteristics such as age, body mass index (BMI) [calculated by dividing weight into height (kilograms per meter)], gender, marital status, number of children, education, profession, and lifestyle variables such as smoking, alcohol, habit of doing regular exercise—that is with ten repetitions three times a day—were obtained. Frequency and intensity of physical exercise were obtained by asking three questions: "How often do you exercise?" "How hard do you exercise?" and "For how long do you carry out the exercise each time?". Patients' clinical profiles (types of lumbar herniated disc) and levels were determined.

Rehabilitation program

Patients included in the study stayed at the hospital for 7.60 ± 1.05 days, and the exercise program started on the first postoperative day. The rehabilitation program lasted for 24 weeks with ten repetition three times a day. The program included repetitive exercises to increase the range of motion of the trunk in flexion and extension and the range of motion of the leg in the early stage, and strengthening exercises that focused on the trunk extensors after the first month. Patients were encouraged to increase their physical activity and given instructions on how to cope with pain in an active way. Training program intensity was increased after 4 weeks in both groups (20 repetitions). Training programs for both groups were designed as home training programs. Patients in both groups received written instructions and schematic illustrations for each exercise and were informed about the aim of the rehabilitation and each prescribed exercise.

Questionnaire

ODI is a ten-item scale instrument with six response alternatives for each item. The total score ranges from 0 to 100:0 to 20 (minimal disability), 20 to 40 (moderate disability), 40 to 60 (severe disability), and 60 to 100 (extremely severe to crippling disability).The ODI rates pain intensity and the degree to which an individual's functional ability in personal care, lifting, walking, sitting, standing, sleeping, sex life, and traveling is affected by back pain [10]. The ODI has demonstrated construct validity through significant positive correlation with physical tests and sign and indication of disease severity [11, 15, 24, 32].

The Prolo Functional Economic Rating Scale (Prolo scale) was used in determining the effect of back pain on the economic and functional level. The outcome total score was rated as "poor" if it was 5 or less, "moderate" if 6 or 7, and "good" if 8–10. The Prolo scale is intended to provide surgeons with a common means by which to evaluate and express the outcome of lumbar spine procedures and to compare economic and functional status of populations at the time of admission and after operations [31]. The scale can also be used as a common standard to compare the status of populations undergoing different treatments to assess their relative effectiveness [29, 36]. Measurements were repeated on the discharged day and in the second and sixth months.

Statistical analysis

Statistical analysis was performed using the statistical package for social sciences (SPSS), version 11.0. Unpaired t test was used to determine the difference between groups 1 and 2 with the ODI and Prolo scale. In the multivariate analysis, the difference among the two groups was tested with logistic regression for each variable separately [7]. The one that had undergone operation was used as a reference. When the reoperation group was assigned as value 1 and the one-operation group as value 0, the odds ratio (OR) and the 95% confidence interval (95% CI) indicated a difference between the groups for categorical variables. Independent variables were age, gender, BMI, smoking, occupation, and not doing regular exercises (scores as 0 or 1, respectively).

Results

Eight weeks after surgery, the majority of patients had no medicine consumption. Demographic characteristics of the sample in terms of age, gender, BMI, marital status, children number, and education are shown in

Table 1 Sociodemographic characteristics. *X* mean, *SD* standard deviation

	Group 1		Group 2	
Age (year) (X ± SD)	35. 94 ± 4.91		35. 86 ± 4.50	
Gender	*n*	%	*n*	%
Male	16	47.06	20	43.48
Female	18	52.94	26	56.52
BMI (kg/m^2) (X ± SD)	26. 43 ± 1.63		26. 40 ± 2.62	
Marital status	*n*	%	*n*	%
Never married	3	8.82	3	6.52
Married	28	82.36	40	86.96
Divorced	3	8.82	3	6.52
Children	*n*	%	*n*	%
≥1	33	97.06	42	91.30
0 (no children)	1	2.94	4	8.70
Education	*n*	%	*n*	%
Elementary school	11	32.35	15	32.60
High school	11	32.35	17	36.97
University	12	35.30	14	30.43

Table 2 Clinical profile

Diagnosis	Group 1		Group 2	
	n	%	*n*	%
$L_{3–4}$	5	14.70	8	17.39
$L_{4–5}$	3	8.82	12	26.08
L_5-S_1	11	32.35	11	23.91
$L_{4–5}+L_5$-S_1	3	8.82	7	15.21
$L_{3–4}+L_{4–5}$	12	35.29	8	17.39

Table 3 Distribution of patients according to occupational load. *ODI* Oswestry Disability Index

Occupational work load	Group 1		Group 2	
	n	%	*n*	%
Light work	8	23.52	10	21.74
Medium strenuous work	13	38.24	17	36.96
Heavy work	13	38.24	19	41.30

Table 1. Table 2 shows the findings of computed tomography and/or myelography with regard to the localization and the extent of disc displacement. Thirteen patients (16.25%) showed positive findings at the $L_{3–4}$, 15 (18.75%) at the $L_{4–5}$, and 22 (27.50%) at the L_5-S_1, ten (12.50%) at the $L_{4–5}$, L_5-S_1, and 20 (25%) at the $L_{3–4}$, $L_{4–5}$ levels. Occupational characteristic was divided into three parts as light (sitting and constant posture) housework (medium strenuous work), and heavy work (lifting or carrying heavy objects, forward bending) (Table 3). Operation reasons were found to be 9% falling, 39% weightlifting (injury at work), 12% trauma (the subject of traumatic disc rupture without simultaneous fracture), 10% pregnancy, 10% other reasons (sports injury). In our study, significant differences in the ODI measurements appeared in favor of group 2 ($p < 0.05$) (Table 4). According to the Prolo scale, it was found that the functional situation was better in the second group ($p < 0.05$) and that the difference increased even more, especially in the postoperative second and sixth months. In the economic situation, significant differences were found in favor of group 2, especially in the postoperative sixth month ($p < 0.05$) (Table 5). The

Table 4 Outcome of patients as measured by Oswestry Disability Index (ODI). *X* mean, *SD* standard deviation

		X	SD	*t* test	*p* value
ODI discharged	Group 1	24.20	4.43	−0 .42	0.888
	Group 2	24.34	4.43		
ODI 2nd month	Group 1	34.47	4.57	12.44	0.000*
	Group 2	21.67	4.52		
ODI 6th month	Group 1	38.14	4.73	21.001	0.000*
	Group 2	17.30	4.11		

*$p < 0.05$

Table 5 Outcome of patients as measured by the Prolo Functional Economic Rating Scale. *X* mean, *SD* standard deviation, *t* *t* test, *p* significance level, *E* economic outcome, *F* functional outcome

		X	SD	*t*	*p*
Prolo E discharged	Group 1	1.67	0.47	2.180	0.032*
	Group 2	1.43	0.50		
Prolo E 2nd month	Group 1	2.32	0.58	0.740	0.461
	Group 2	2.23	0.43		
Prolo E 6th month	Group 1	2.20	0.59	−10.135	0.000*
	Group 2	3.67	0.70		
Prolo F discharged	Group 1	1.88	0.32	0.438	0.662
	Group 2	1.84	0.36		
Prolo F 2nd month	Group 1	1.97	0.45	−3.012	0.003*
	Group 2	2.30	0.51		
Prolo F 6th month	Group 1	1.52	0.56	−13.907	0.000*
	Group 2	3.60	0.77		

*$p < 0.05$

logistic regression model showed statistically significant odds ratios for the six predictor variables at baseline (Table 6).

Result indicates that lack of regular exercise is a significant risk factor for the development of lumbar disc degeneration and its progression. The confounding effects of other explanatory variables (age, BMI, gender, smoking, occupation) were small.

Discussion

Repeated surgery is an important outcome of treatment and it may indicate a failure in the quality of initial care. The risk of reoperation should thus be fully taken into account when estimating the cost-effectiveness of options for treating lumbar disc herniation [19]. Recurrent herniation following disc excision has been reported in 5–11% of patients. Recurrent lumbar disc herniation was defined as disc herniation at the same level, regardless of ipsilateral or contralateral herniation, with a pain-free interval greater than 6 months. The 5-year risk of reoperation was 5%, and it increased to 7% at 10 years [34]. Bruske-Hohlfeld et al. reported that patients with a surgically treated lumbar disc prolapse had an

Table 6 The prediction of the risk factors in lumbar disc surgery. *B* logistic regression coefficient, *p* significance level, *OR* odds ratio, *CI* confidence interval of odds ratio

Variable	B	*p*	OR	95.0%	CI
Age	0.023	0.965	1.023	0.367	2.851
Gender	−0.010	0.987	0.990	0.288	3.404
BMI	1.019	0.127	2.771	0.748	10.270
Smoking	0.449	0.422	1.566	0.524	4.685
Occupation	0.150	0.815	1.162	0.330	4.090
Exercise	1.525	0.013	4.595	1.381	15.284

approximately ten–fold risk of another disc operation compared with the general population [3]. The risk did not vary between genders, but patients younger than 50 years had a somewhat higher risk of reoperation than the older patients [19].

In this study, 34 (42.5%) of the 80 eligible patients throughout the 5-year term had undergone more than one operation. Twenty-seven who had undergone reoperation had undergone ipsilateral (same-level) operation, one below or above the previous operation level, and seven different-level operations. Gender (OR, 0.990; Cl, 0.288–3.404) and age (OR,1.023; Cl, 0.367–2.851) were not found to be an important factor with respect to reoperation.

Lewis et al. showed that 93% of patients were able to return to work 5–10 years after surgery. In our study, only of 32 (40%) patients had returned to work 6 months after the operation. There was no significant difference between the groups regarding the number of days on sick leave or return to work within 6 months[23]. In a recent review, Videman and Battie outlined the complexity of the relation between occupational risk factors (heavy lifting, sitting, bending) and disc degeneration. It was intriguing to find that none of the classic occupational risk factors were predictive of disc degeneration [38]. In this study, as in Videman and Battie's study, it was found that occupational risk factors were of no significance with regard to reoperation and disc surgery.

Exercise can increase the probability of the return to work for patients after lumbar disc surgery. The encouraging results indicate that a short postoperative exercise program may offer a cost-effective way of improving the outcome of surgery for patients with prolapsed intervertebral disc [5, 8]. Intensive, standardized medical exercise training that ignores fear of provoking pain and begins 4 weeks subsequent to surgery seemed to reduce postoperative disability at least in the first 6 months [20]. Manniche et al. reported favorable effects on patients who performed high-intensity dynamic back extension and abdominal exercises starting 5 weeks after surgery on patient disability index and work capabilities [26].

In our study, similarly, we gave an intensive training program after 4 weeks, and the program continued for 6 months. Treatment programs that emphasize active rehabilitation and physical conditioning have been reported to significantly enhance cardiorespiratory fitness; increase muscular strength and endurance; improve flexibility; decrease perceptions of pain, depression and disability; improve functional status; and facilitate early return to work [13, 22].

Recurrences of persistent pain and work absenteeism were fewer among those who maintained regular exercise habits after an active treatment for recurrent CLBP than among those who were physically inactive [35]. Seventy percent of patients included in our study did not have the habit of doing exercise regularly; 85.30% of those in group 1, and 58.70% of those in group 2. Accordingly, it may be emphasized that the habit of doing exercise is essential in preventing reoperation.

A limitation of this study is that the follow-up period was very short. In order to evaluate the effect of the exercise programs and training given, longer-term studies are required. In order to give the 1- and 2-year results of these patients, our studies are continuing.

Conclusion

Each surgical operation performed for lumbar disc herniation has the risk of recurrence besides increasing functional and economic losses. In conclusion, eliminating or decreasing risk factors that may be a potential in lumbar disc herniation is important from the economic, functional, and reoperational aspect. For this purpose, physiotherapy studies must be started in the early postoperative period, and the habit of doing regular exercise must be instilled in the patients.

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