

Clinical Trial of Postoperative Dynamic Back Exercises After First Lumbar Discectomy

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Ninety-six patients who had undergone first-time discectomy for herniated lumbar intervertebral discs were consecutively randomized to two physical rehabilitation programs: a program of high-intensity, dynamic back extension and abdominal exercises with occurrence of low back pain being the limiting factor or a traditional program of mild, generally mobility-improving exercises within pain limits. Both groups underwent 14 hours of treatment during a 6-week period 5 weeks after surgery.

At 26 weeks' follow-up, results indicated that patients who did the high-intensity exercises experienced greater success with regard to the patient disability-index and work capabilities. After 1 year, a trend that favored the use of intensive exercises could be observed. No differences were found in pain or objective measurements.

A rehabilitation program of intensive exercises with occurrence of back pain being the limiting factor appears to increase patient behavioral support, resulting in work capacity improvements and patient self-rated disability levels. The results indicate that a 6-wk, 14-hr postoperative rehabilitation program is inadequate if objective postoperative deficit improvements are the desired goal. [Key words: low back pain, discectomy, rehabilitation, back exercises, clinical trial]

Approximately 25% of patients who undergo a first-time operation for intervertebral disc protrusion have troublesome postoperative symptoms.² Recent attempts at improving these results include increased scrutiny in patient selection and increased emphasis on operative procedures.³ Postoperative rehabilitation was recognized as having influence on surgical

results as early as the 1960s.^{11,31} Postsurgical rehabilitation programs were recommended to all patients. Many hospitals have offered postoperative rehabilitation programs, general spinal and postural information, and physical fitness recommendations during the years.³⁴ This has been done without positive scientific documentation.³²

A positive relationship between chronic low back pain and reduced endurance of trunk musculature has been documented.⁴ Low back training protocols have been proven capable of improving function and pain levels and increasing back muscle endurance in many patients with chronic low back pain.^{1,5-7,10,12,14,15,18,19,21-23,26-30} In addition, patients who previously would have had an operation for herniated lumbar disc have benefited from lengthy back training programs,¹⁹ thereby avoiding the postoperative physical deficits found in such patients.^{13,24} A negative correlation between physical fitness level and physical dysfunction and depressive symptoms was shown in individuals with chronic back pain.²⁵ However, inconsistencies between chronic pain experienced and physical capabilities of such patients have been reported.⁹

The hypothesis tested in this trial was that short-term, high-intensity, dynamic exercises performed without regard to back pain or fear of activity could result in behavioral changes in patients after discectomy, thus increasing the general activity levels and working capabilities of these patients. Results of a program of high-intensity back exercises were compared with those of a conventional rehabilitation program that included generally mild mobility-improving exercises. Both rehabilitation programs started 5 weeks after lumbar operation.

For assessing low back pain, leg pain, disability, and physical impairment, we used the "Low Back Pain Rating Scale."¹⁹⁻²²

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Methods

All consecutive patients between 18 and 70 years of age who were living in Copenhagen County and experienced first-time operation for lumbar disc protrusion at the Department of Neurosurgery were allowed to participate in the study. Exclusion criteria were previous lumbar surgery; postoperative complications; spondylolysis/spondylolisthesis; or previous somatic disease or mental illness that might interfere with training.

Of 98 patients who fulfilled the inclusion/exclusion criteria and operated on in the period from September 1, 1989, to May 1, 1990, 96 entered the study. All received written patient information in accordance with the "Helsinki II Declaration." The patients were randomized by the drawing of lots into one of two physical rehabilitation groups (Table 1). Data were encoded according to the "Low Back Pain Rating Scale" at inclusion, which was 4-5 weeks after the operation; after 6 weeks of intervention; and again at follow-up times of 6, 26, and 52 weeks. The rehabilitation programs were initiated the week after the primary data were registered. The rehabilitation took place at one of three participating departments of rheumatology, depending on the patient's location of residence.

Demographic data, *back pain* (total 0-30 points) and *leg pain* (total 0-30 points) at the moment (0-10 points), the worst pain within the last 2 weeks (0-10 points), and the average level of pain within the last 2 weeks (0-10 points), and *disability* (0-30 points) were registered by self-report with regard to 15 daily activities. (Example of questions are: Can you put on your shoes and stockings by yourself? and Can you get up from a low armchair without difficulty?) The "Low Back Pain Rating Scale"²⁰ was used to register physical impairment (0-40 points) (measurements included the *endurance* test of back muscles; *modified Schober's* test, patient *mobility* test and *use of analgetics*^{20,22}). At 26 and 52 weeks' follow-up, the patient information was gathered by questionnaires mailed to the patients. At those times, "physical impairment" was substituted with "*days out of work*," according to the Nordic Questionnaires.¹⁶ All data were collected by three observers who did not know the training group to which the patient had been assigned. For each patient, all examinations were performed by the same observer.

Statistics

The patients' overall assessments at follow-up of 52 weeks, pain score, disability score and days out of work at follow-up of 26 weeks and 52 weeks, and physical impairment at 12 weeks of follow-up were regarded as the most important result parameters.

The nonparametric methods of Mann-Whitney and Wilcoxon's sign test and the Medstat program were used.³³ Statistical significance was registered at the 5% confidence level.

A full version of the "Low Back Pain Rating Scale" and the rehabilitation programs is available from Claus Manniche, MD, and Hanne F. Skall on request.

Results

Table 2 summarizes the characteristics of the 96 patients in the study. Of the 96, 84 (88%) completed the program and had a concluding examination. Of these, 83 (86%) patients completed the follow-up at 6 weeks, 80 (83%) completed the follow-up at 26 weeks, and 82 (85%) completed the follow-up 52 weeks.

Medians of point ratings of the randomized groups in accordance with the dimensions of the "Low Back Pain Rating Scale" (back pain, leg pain, disability, and physical impairment) are presented in Table 3. No statistically significant differences between group A (traditional) and group B (high-intensity exercises) were observed at inclusion, at conclusion, or at follow-up of 6 weeks. At follow-up of 26 weeks, the only statistical difference was demonstrated in the disability index in favor of group B ($P = 0.029$). After 1 year, a trend appears ($P = 0.09$).

Differences in median point scores (pretraining minus follow-up of 26 weeks) showed statistically sig-

Table 1. The Rehabilitation Programs

Program A (traditional)

Training principle: 15 mild exercises, 10 repetitions each, conducted in classes of 2-6 patients all starting at the same point of time. Pain or inconvenience that occurred during the training was reason for stopping the exercise in question.

The program started with six 30-minute sessions, twice a week in a hot water training pool, and consisted of 15 mild, general mobility improving exercises with 10 repetitions of each, followed by 5 stretching exercises. The next 3 weeks six 1-hour sessions were conducted in the gymnasium following the principles mentioned above but starting with application of hot compresses. There was no fixed range of the back movements, but the patients were told to stop the specific exercise if any pain or inconvenience occurred.

Program B (intensive exercises)

Training principle: 5 heavy exercises, 50 repetitions, conducted in classes of 2-6 patients starting consecutively. Pain in the lumbar area that occurred during the training was not reason enough for stopping.

In the gymnasium six 1-hour sessions were conducted twice a week. Each session contained an application of hot compresses and 50 high intensity repetitions in series of 10 of the 5 following heavy exercises:

Leg lifting, from 45 to 0 of hip flexion, the patient lying prone on a couch, headpiece declined 45 downwards, with legs resting on the headpiece

Trunk lifting, from 45 to 0 of hip flexion, the patient lying prone on a couch, headpiece declined 45 downwards, with trunk resting on the headpiece

Abdominal strengthening, from supine to 45 of hip flexion

Leg abduction, Sidelying

Leg adduction, Sidelying

Six minutes of exercise on a training bicycle at submaximal resistance and 5 stretching exercises completed each session.

The next 3 weeks of training consisted of six 30-minute sessions in a hot water training pool, following the principles mentioned above. In the water there were no limits to the range of movement and two of the exercises contained rotatory elements. The patients were told that pain was likely to occur during the training period, but as long as it was located to the lumbar area they were to continue.

A total of 14 hours, including 5 sessions of instruction and ergonomics guidelines, were given in each group during 6 weeks.

nificant results (Wilcoxon's sign test) in group A ($P = 0.0007$) and group B ($P = 0.00002$) with regard to disability and in group A ($P = 0.00024$) and group B ($P < 0.00001$) with regard to physical impairment (before training minus follow-up of 6 weeks).

Figure 1 gives the results of the patients' work capabilities at 26 weeks of follow-up. The difference was statistically significant, with the group doing high-intensity exercises experiencing greater success ($P = 0.026$). At 52 weeks of follow-up, the difference was insignificant ($P = 0.19$).

At 52 weeks of follow up 12 of 40 (30%) of the patients in group A and 6 of 42 (14%) in group B had not returned to their original work schedule because of back pain. The reasons are given in Table 4. The differences in return to work frequencies (the difference between 30% and 14% is 16%) were insignificant ($P = 0.15$ by Fisher's exact test; $\pm 95\%$ confidence limits of -2% and -33%). The risk of having overseen a difference in return to work frequencies in 10% or more between the randomized groups were Beta (10%) = 75%. Equivalent Beta (20%) was 33%.

The patients were asked to give an overall assessment at follow-up of 52 weeks. The answers "very satisfactory" or "satisfactory, little discomfort" were given by 28 of 40 (70%) of patients in group A and 32 of 42 (76%) in group B. The answer "acceptable, some discomfort" was given by 10 of 40 (25%) patients in group A and 8 of 42 (19%) in group B. Two patients in group B gave the answer "unchanged," and 2 patients in group A gave the answer "aggravated." There was no statistically significant difference ($P = 0.42$ by Mann-Whitney test).

No outcome differences were observed among the patients from the three participating rheumatology departments, indicating that the training administered was uniform.

Table 2. Characteristics of Initial 96 Patients

		10th and 90th Median Percentile
Women/men	49/47	
Age (yr)		44 31/60
Low back pain, duration		
< 2 mo	33	
> 2 mo	63	
Full-time employed	70	
Part-time employed	10	
Self-reported back-straining work	62	
Clinical findings before inclusion		
Positive straight leg raising test	14	
Motor deficits	21	
Sensibility loss	29	
Operation findings		
Disc extrusion	54	
Disc protrusion	39	
Other abnormal findings	3	

Table 3. Title

	Group A	Group B
Low back pain (medians, 10th and 90th percentile)		
Before treatment	7.1 (0.0-18.0)	5.5 (0.0-14.5)
After treatment	3.4 (0.0-15.0)	2.0 (0.0-18.0)
Follow-up 6 weeks	2.4 (0.0-12.0)	1.8 (0.0-14.0)
Follow-up 26 weeks	5.5 (0.0-19.6)	5.2 (0.0-20.8)
Follow-up 52 weeks	6.5 (0.0-18.9)	3.7 (0.0-18.1)
Mann-Whitney (follow-up 26 weeks), A/B; $P = 0.44$		
Mann-Whitney (follow-up 52 weeks), A/B; $P = 0.28$		
Wilcoxon's sign test (before follow-up 26 wk), A; $P = 0.88$; B; $P = 1.00$		
Leg pain		
Before treatment	4.8 (0.0-17.0)	4.5 (0.0-13.8)
After treatment	3.2 (0.0-12.0)	2.2 (0.0-14.0)
Follow-up 6 weeks	3.0 (0.0-10.0)	3.0 (0.0-11.8)
Follow-up 26 weeks	5.0 (0.0-17.1)	3.0 (0.0-21.7)
Follow-up 52 weeks	2.2 (0.0-17.9)	0.8 (0.0-17.4)
Mann-Whitney (follow-up 26 weeks), A/B; $P = 0.66$		
Mann-Whitney (follow-up 52 weeks), A/B; $P = 0.74$		
Wilcoxon's sign test (before follow-up 26 wk), A; $P = 0.44$; B; $P = 0.46$		
Disability		
Before treatment	11.5 (4.2-20.0)	10.8 (0.3-14.9)
After treatment	6.1 (2.8-16.9)	4.5 (1.2-12.5)
Follow-up 6 weeks	4.3 (1.6-13.0)	4.4 (0.8-10.5)
Follow-up 26 weeks	6.5 (2.1-18.1)	4.0 (0.3-14.9)
Follow-up 52 weeks	6.0 (2.8-19.0)	4.2 (1.1-11.1)
Mann-Whitney (follow-up 26 weeks), A/B; $P = 0.029$		
Mann-Whitney (follow-up 52 weeks), A/B; $P = 0.094$		
Wilcoxon's sign test (before follow-up 26 wk), A; $P = 0.0007$; B; $P = 0.00002$		
Physical impairment (medians, 10th and 90th percentile)		
Before treatment	16.8 (9.1-22.8)	16.2 (6.1-20.0)
After treatment	11.8 (8.3-17.9)	11.8 (8.3-17.9)
Follow-up 6 weeks	12.3 (6.4-19.5)	12.5 (6.1-20.0)
Mann-Whitney (follow-up 6 weeks), A/B; $P = 0.42$		
Wilcoxon's sign test (before follow-up 6 wk), A; $P = 0.00024$; B; $P < 0.00001$		

Return to work

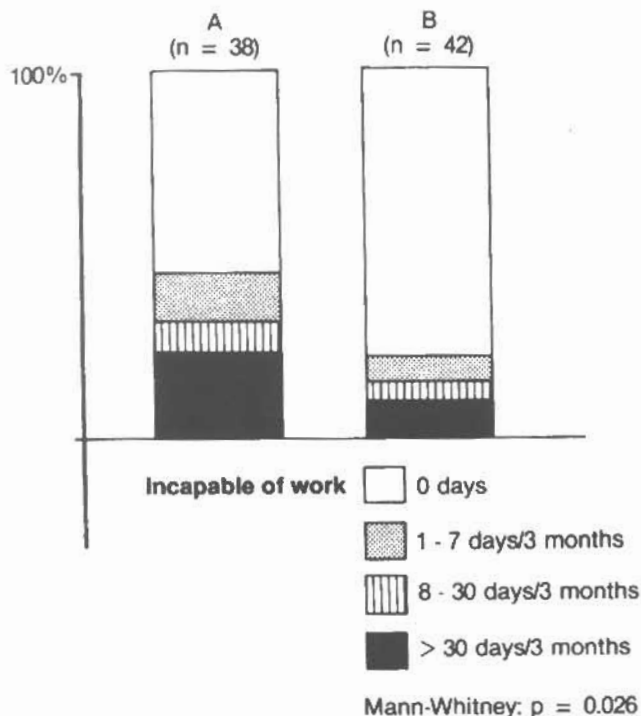


Figure 1. Incapacity of doing the normal work at the 26-week follow-up. According to the Nordic Questionnaires of back pain,¹⁶ the patients answered the question: "What is the total length of time that low-back trouble has prevented you from doing your normal work (at home or away from home) during the last 3 months?"

Dropouts

Twelve patients dropped out during the intervention period. The reasons are listed in Table 5. No side effects or complications that could be related to the training were observed. One patient was excluded from the study because of a retrospective observation of a spondylolisthesis that was visible on the radiograph before the operation.

Discussion

In a clinical trial of patients with acute low back pain, Fordyce et al.⁸ compared results of patients in two treatment programs. One was a rehabilitation program that included back exercises. The program started at a fixed point of time; the type of exercise performed was specified, a preset number of repetitions was required without regard to patient severity of pain severity. The other program was a traditional rehabilitation program, in which the prescribed analgesics and exercises and the resumed limited activities were based on the individual patient's requests and the physician's judgment. The first program suc-

Table 4. Patients Not Returned to Their Work at Follow-up 52 Weeks

	Group A	Group B
Change to less heavy work	4	1
Convalescent	1	2
Long-term sick leave	5	3
Work disability pension	2	0
Total	12/40 = 30%	6/42 = 14.3%

ceeded in preventing chronic back pain and decreasing disability.

In this study, similar observations with patients experiencing first-time operation for herniated intervertebral discs were seen. Table 3 demonstrates that patients in the two groups experienced no differences in back pain, leg pain, or physical impairment (including back muscle endurance levels). But patients who performed the high-intensity, dynamic exercises had improved disability index scores. They also had better working capacity levels at follow-up of 26 weeks. The better results for the patients in the group B still were apparent at 52 weeks of follow-up.

The demonstrated difference between the groups in disability scoring can be explained only by a difference in the rehabilitation programs. The results indicate that a program of high-intensity back exercises that includes a fixed training regimen and does not allow pain to be a limiting factor provides patients with superior behavioral support. Patients treated with these regimens attain a good working relationship with their "new" spines soon after their operations. They confront their fears and insecurities and learn that symptoms related to training are not necessarily dangerous. Pain and function no longer have the same association. Fordyce et al.⁹ and Linton¹⁷ have reported a discrepancy between chronic pain experienced by patients and their physical capabilities.

Because differences in the rehabilitation programs are dependent on the physiotherapists' disposition and do not require more resources or subject the patients to increased risks, the authors regard a small minimal relevant difference of 5-10% as clinically relevant. For example, a difference of 10% in "return

Table 5. Drop-outs

	Group A	Group B
Side-effects to exercises	0	0
Reprolapse	1	1
Lumbar discitis	2	0
Spondylolisthesis	0	1
Personal	0	2
Absence from treatment	4	1
without reason		
Total	7	5

to work capability" could greatly reduce the number of disabled patients who have undergone back operations. The personal and socioeconomic factors should not be underestimated.

The data illustrate that in the short-term, high-intensity exercises do not improve postoperative deficits more than a traditional rehabilitation program. A rehabilitation period of 14 hours is insufficient to greatly improve the postoperative deficits. The improvement in the objective parameters seen probably are not attributable to the exercise programs, but more likely are a result of the time factor relating to the operative procedure.

A previous study¹⁹ concluded that patients with chronic low back pain after first time discectomy achieved good progress with an intensive, dynamic exercise protocol of 24 sessions in 12 weeks, starting 14–60 months after the operation. Improvements were seen in back pain, sciatica, disability, and all of the objective measurements.

When the results of our study are compared with previous data,¹⁹ it must be concluded that intensive dynamic exercises performed for a relatively short period, beginning 4–5 weeks after spinal operation, provide patients with behavioral support that in the long term could improve functional levels. It is assumed that if improvements in physical deficits and reduction of chronic back pain postoperatively are goals, the rehabilitation programs must be performed for longer periods of time. For example, two times per week for a 3-mo period of time. Training protocols must include dynamic exercises for the back extensors and abdominal muscles, and patients must do many repetitions of the exercises and follow the adage: "Don't let the pain be your guide."

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