J Neurosurg 69:649–652, 1988

Changes in radicular function following low-back surgery

GERHARD BLAAUW, M.D., PH.D., REINDER BRAAKMAN, M.D., PH.D., GEERT JAN GELPKE, M.SC., AND RAM SINGH, M.D., PH.D.

Departments of Neurosurgery, St. Clara Hospital, University Hospital Rotterdam-Dijkzigt, and St. Franciscus Hospital; and Department of Public Health and Social Medicine, Erasmus University, Rotterdam, The Netherlands

✓ Results of neurological assessment 1 year following surgical treatment of herniated lumbar intervertebral discs and lumbar stenosis are reported in 443 patients. The data were collected using separate series of questionnaires to be completed by the patient and the surgeon. Preoperatively, motor loss was reported by 12% of patients, while surgeons found motor weakness in 28%. Postoperative motor loss was still present in 24% and 25% of these cases, respectively; the operation had caused or aggravated motor loss in 5% and 3% of cases, respectively. Sensory phenomena were reported by 53% of the patients, while surgeons found sensory loss in 45%. Sensation was reported as abnormal 1 year after surgery both by patients and by surgeons in one-third of these cases. Sensory loss, considered by the patient to be caused or aggravated by operation, occurred in 15% of cases and in 12% of cases the surgeons agreed. Preoperatively, unilaterally diminished knee and Achilles tendon reflexes were found in 9% and 42%, respectively; at 1 year after surgery, these had recovered in 65% and 57% of cases, respectively. Surgery caused or aggravated unilaterally diminished knee or ankle jerks in 3% and 10% of cases, respectively.

KEY WORDS • **nerve root** • **radicular deficit** • **herniated intervertebral disc** • **lumbar disc surgery** • **outcome**

RELIEF of radicular leg pain such as sciatica is usually the main purpose of treating patients with lumbar herniated discs or lumbar spinal stenosis. It is generally accepted that a certain period of observation is advisable before patients are referred to surgery.[6] The appearance of neurological symptoms due to radicular compression, including reflex abnormalities, sensory changes, and especially motor deficits, often gives rise to the feeling that surgery must not be postponed. This is certainly the case when cauda equina symptoms are present.

In the present study the result of surgery on the outcome of radicular deficit was evaluated. This study forms part of a larger investigation aimed at answering various questions concerning the efficacy of health care and diagnostic and therapeutic approaches in patients with radiating leg pain. Radiological data used in this study have been reported previously by Schipper, *et al.*[3]

Clinical Material and Methods

This study includes patients with radiating leg pain in the area of the sciatic or femoral nerve, with or without the sensations of numbness or motor weakness. Patients who had suffered spinal trauma in whom spondylolisthesis was present and patients with a tumor of the cauda equina, the spine, or the pelvis were excluded.

Between August, 1983, and June, 1985, data were collected from 746 patients who were referred to the neurosurgical departments of three Rotterdam hospitals: the University Hospital, the St. Clara Hospital, and the St. Franciscus Hospital. Of these, 443 underwent surgery as well as neurological assessment 1 year later. Preoperatively, 394 (88.9%) of the 443 patients had a distinct prolapsed disc (with or without spinal stenosis) and 34 (7.7%) had lumbar spinal stenosis only. In 15 of the patients (3.4%) there was no prolapsed disc or stenosis (Table 1). Surgery was performed on 405 patients for the first time, on 36 for the second time, and on two for the third time. The age distribution is shown in Table 1; 63% of the patients were male and 37% female.

The data were collected using one series of questionnaires to be completed by the patients and another series to be filled in by the surgeons. There was a questionnaire for the time of entry into the study, and one for 6 weeks, 6 months, and 1 year later. For the present study the 1-year follow-up data were taken as a

TABLE 1

Patients' age and pathological diagnosis

Age (yrs)	Series Total	Disc Herniation	Spinal Stenosis Only	Neither Diagnosis
≤ 29	13%	14%	0%	7%
30–39	27%	30%	3%	13%
40–49	27%	27%	12%	40%
50–59	20%	19%	35%	33%
≥ 60	13%	9%	50%	7%
no. of cases	443	394	34	15

TABLE 2

Patients' complaints and examiners' findings before surgery

Factor	Cases	
	No.	Percent
total cases	746	
operated, with 1 year follow-up (this series)	443	100
patients' complaints		
motor weakness	54	12
tingling &/or other sensory phenomena	233	53
examiners' findings		
unilat diminished or absent reflex		
knee jerk	40	9
ankle jerk	184	42
sensory disturbance	201	45
motor loss	123	28

TABLE 3

Patients' complaints of muscle weakness before and 1 year after surgery

Preop Complaint	Complaint 1 Yr Postop		
	No	Yes	Total
no	368	21	389
yes	41	13	54
total	409	34	443

TABLE 4

Patients' complaints of tingling and sensory phenomena before and 1 year after surgery

Preop Complaint	Complaint 1 Yr Postop		
	No	Yes	Total
no	179	31	210
yes	161	72	233
total	340	103	443

TABLE 5

Number of patients with any motor deficit before and 1 year after operation

Preop		1 Yr Postop	
Status	No.	Status	No.
deficit	123	normal	92
		improved	13
		unchanged	13
		worse	5
normal	320	normal	311
		deficit	9

measure of outcome. The patients were examined and scored by multiple investigators. Reflexes and motor power were examined using the conventional manual technique. Sensory function was tested by touch and pinprick.

The operation for the herniated lumbar disc required an interlaminar approach, combined with a small laminotomy in the majority of the patients. This technique permitted proper visualization of the root involved. Subsequently, the herniations and the contents of the discs involved were removed. In the case of a bony spinal stenosis, adequate lateral decompression was performed, if necessary combined with extensive laminectomy.

Results

Patients' Comments

At the time of admission only 54 patients (12%) complained of "muscle weakness" (Table 2), and 1 year later this condition persisted in 13 of them. Of the 389 patients who did not complain about muscle weakness at the time of admission, 21 (5%) did so after 1 year (Table 3).

Preoperatively, more than half of the patients (233, or 53%) complained about tingling and/or other sensory phenomena like sensory loss (Table 2). One year later, 72 of these patients still reported abnormal sensation. Of the 210 patients who had regarded sensation to be normal prior to surgery, 31 (15%) reported persistent abnormal sensation postoperatively (Table 4).

Examiners' Findings

Data concerning motor function are depicted in Table 5. At the time of admission, motor deficits were found in 123 patients (28%). Significant to slight improvement of motor loss often occurred after operation. After 1 year normal muscle power was achieved in 92 patients and 31 patients still had a motor deficit. In five patients there was further deterioration of muscle power. Of the 23 patients who had a severe deficit before surgery, normal strength was regained in 11. Nine patients had normal motor power preoperatively, but showed motor deficit after surgery. The outcome in the various muscle groups is presented in Table 6.

Forty patients (9%) had a diminished knee jerk preoperatively, and in 14 of them it was still abnormal 1

TABLE 6

*Comparison of motor deficit before and 1 year after operation in seven muscle groups**

Preop Status	Postop Status	Dorsal Flexion, Foot	Dorsal Flexion, Hallux	Plantar Flexion, Foot	Muscle Groups			
					Peronei	Quadriceps	Hamstrings	Glutei
deficit		63	86	42	41	17	18	13
	normal	44	65	32	31	15	16	13
	improved	7	9	3	5	0	0	0
	unchanged	10	9	4	2	2	2	0
	worse	2	3	3	3	0	0	0
normal		380	357	401	402	426	425	430
	normal	373	350	395	393	423	422	425
	deficit	7	7	6	9	3	3	5

* Several patients had a motor deficit in more than one muscle group.

TABLE 7

Asymmetrical knee jerk before and 1 year after surgery

Preop Abnormal Knee Jerk	Abnormality 1 Yr Postop		
	No	Yes	Total
no	389	14	403
yes	26	14	40
total	415	28	443

TABLE 8

Asymmetrical ankle jerk before and 1 year after surgery

Preop Abnormal Ankle Jerk	Abnormality 1 Yr Postop		
	No	Yes	Total
no	232	27	259
yes	105	79	184
total	337	106	443

year later (Table 7). Of the 403 patients who had normal knee jerks before operation the reflex became diminished on one side in 14 patients. In 184 patients (42%) the ankle jerk was reduced unilaterally prior to surgery, and remained so 1 year later in 79 of these patients (Table 8). Of the 259 patients with normal ankle jerks before operation, this reflex had disappeared after surgery in 27.

Preoperatively, 201 patients showed loss of sensation, usually with a segmental pattern; 138 of these recovered completely. Of the 242 patients with normal sensation on admission, 30 showed some loss 1 year postsurgery (Table 9).

TABLE 9

Sensation before and 1 year after surgery

Preop Sensation	Status 1 Yr Postop		
	Normal	Abnormal	Total
normal	212	30	242
abnormal	138	63	201
total	350	93	443

Discussion

Operations for lumbar disc herniation or for lumbar spinal stenosis are common. Neurological deficits and in particular motor weakness prompt a decision to operate in order to decompress the nerve root involved. However, very few studies report on the incidence of motor deficits in populations with lumbar disc herniation, and even fewer reports are available concerning the effect of surgery on such deficits. It is not surprising that, in the present study of a population seen and treated in neurosurgical outpatient clinics and clinical departments, the incidence of motor loss (28%), sensory disturbances (45%), and diminished or absent reflexes (51%) was frequent. These percentages are in accordance with those reported by Jensen and Lund,[1] Lewis, *et al.*,[2] Spangfort,[4] and Weber[6] (Table 10).

The physicians reported a much higher rate of motor loss than the patient. This is in agreement with other reports. The patient is concerned with sensory phenomena, such as pain and disturbance of sensation, and is often unaware of any loss of motor function. Diminished or abolished knee and Achilles tendon reflexes are in some way related to the level of the lumbar disc herniation. This relationship forms the basis of another study.

In this study, motor power was examined using a manual technique. Consequently, the reported number of cases with mild paresis may be too high, as many patients with severe pain are reluctant, because of a fear of pain, to use maximum motor power in the affected leg.

Normal muscle power was found 1 year after surgery in about 75% of patients who had muscle weakness preoperatively; among these were up to 50% of patients with a severe deficit. A further deterioration of muscle power was observed in 4% of the patients with normal motor power prior to surgery. We believe this must also be the case in other clinics, although it cannot be confirmed from published studies which only present overall results, rather than specific pre- and postopera-

TABLE 10

Incidence of neurological deficit in various series reported in the literature

Factor	Jensen & Lund, 1955	Spangfort, 1972	Weber, 1975, 1983	Lewis, *et al.*, 1987	Blaauw, *et al.*, 1988
no. of cases	235	2504	270	100	443
surgical treatment only		+		+	+
surgical or conservative management	+		+		
"paresis"	35%		50%		28%
"weakness"				61%	
paresis of dorsal flexor, foot		30%			
unilat diminished knee/ankle reflex	45%	30%		43%	51%
sensory deficit	40%			50%	45%

tive findings for the individual patients. It is obvious that in some patients neurological symptoms may appear due to the operation, while in others surgery will initiate the recovery of such symptoms. In comparing the patients as groups, these data will disappear. This may be the reason why mention of postoperative deterioration is uncommon. The causes of deterioration in this large series, where all patients were operated on by experienced neurosurgeons, need to be investigated so that prevention will be possible.

About 60% of patients with diminished knee jerk or ankle jerk before operation regained normal reflexes 1 year after surgery. On the other hand, in 3% of patients with normal knee jerks and 10% of patients with normal ankle jerks, there were diminished or absent reflexes after surgery. The same tendency was seen with regard to sensory disturbances. The fact that a large number of patients showed significant improvement of neurological dysfunction after surgery is in itself not an argument for operating on patients with neurological deficits.

Weber[5,6] reported his results 1, 4, and 10 years after randomized treatment in a selected series of 64 patients with paresis who were able to tolerate their pain and discomfort during the acute phase of the disorder and had no major neurological deficit requiring emergency surgery. Of these 64 patients, 32 underwent surgery and 31 were treated conservatively (one patient was excluded). At the 1-year follow-up examination, the trial showed a statistically significantly better result in the surgically treated group compared with the conservatively treated group. After 4 years the results were even better in both groups, but the difference was no longer statistically significant. This difference between the two groups of patients became less pronounced during the subsequent years. Improvement of muscle strength continued over the years, the patients' recovery being unrelated to the type of treatment. In Weber's series, one-third to one-half of all muscle groups recovered during the 1st year, and after 10 years in some patients a motor deficit was still present, irrespective of the type of treatment.

In our series significant improvement of muscle weakness occurred in about 80% of the affected muscle groups. Some sensory dysfunction was present after 10 years in 35% of the patients reported by Weber.[6] Our series contrasts favorably: 63 patients (14%) showed disturbance in sensation 1 year after operation. According to Weber, muscle weakness is a doubtful indication for surgery if the paresis is of unknown duration. However, he regarded surgery as the therapy of choice if the pressure on the nerve root can be relieved "immediately" after the appearance of the paresis. So far, this opinion has not been confirmed or disproved; however, it supports the need for another, preferably multicenter, prospective randomized clinical trial. Such a trial must contend with the same difficulty as in Weber's series, in which patients who were assigned to a conservatively treated group could not tolerate the pain during the period of observation and required surgery, thus frustrating the object of randomization.

References

1. Jensen OØ, Lund M: [The prognosis of lumbago-sciatica.] **Ugeskr Laeger 117**:67–73, 1955 (Dan)
2. Lewis PJ, Weir BKA, Broad RW, et al: Long-term prospective study of lumbosacral discectomy. **J Neurosurg 67**:49–53, 1987
3. Schipper J, Kardaun JWPF, Braakman R, et al: Lumbar disk herniation: diagnosis with CT or myelography? **Radiology 165**:227–231, 1987
4. Spangfort EV: The lumbar disc herniation. A computer-aided analysis of 2504 operations. **Acta Orthop Scand Suppl 142**:1–95, 1972
5. Weber H: The effect of delayed disc surgery on muscular paresis. **Acta Orthop Scand 46**:631–642, 1975
6. Weber H: Lumbar disc herniation. A controlled, prospective study with ten years of observation. **Spine 8**: 131–140, 1983

Manuscript received January 22, 1988.

Address reprint requests to: Gerhard Blaauw, M.D., Ph.D., Department of Neurosurgery, De Wever Ziekenhuis, P.O. Box 4446, 6401 CX Heerlen, The Netherlands.