Neurologic signs in lumbar disc herniation

Preoperative affliction and postoperative recovery in 150 cases

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We studied prospectively 165 consecutive patients operated on for lumbar disc herniations. Neurologic examination was performed preoperatively and at 4, 12, and 24 months postoperatively according to a protocol. Preoperatively 69% of the patients showed a neurological disturbance corresponding to the level of disc herniation and 62% a corresponding sensory deficit. Recovery of the neurological deficit was seen in half of the cases at 2 years postoperatively, the main part of this improvement occurred within 4 months after the operation. Neurologic recovery correlated to a good surgical outcome, and a short history of disc herniation prior to the operation correlated to postoperative neurologic improvement. The straight leg raising test correlated to preoperative neurologic deficit, but not to postoperative recovery. Motor power disturbance of the extensor hallucis longus muscle recovered in more patients than reflex disturbances. Sensory disturbances had the lowest recovery rate. Our study demonstrates a correlation between routine postoperative neurologic findings and the patient's self-assessed outcome of surgery.

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Neurologic disturbance, as demonstrated by reduced knee or ankle jerk or reduced dorsi flexion power of the big toe (EHL) or sensory disturbance, is common in lumbar disc herniation and is recorded in up to 80% of operated cases (Spangfort 1972, Blaauw et al 1988, Jönsson & Strömqvist 1993). The main purpose of surgical treatment of disc herniation in the lumbar spine is pain relief, but motor and sensory improvements often can be expected and, in the case of a cauda equina syndrome, this is the main purpose of the operation.

In major textbooks (McCulloch 1989, Frymoyer 1991, Hardy 1993), as well as in common clinical practice, it is generally accepted that the commonest finding in L3-L4 herniation is reduction of the patellar tendon reflex; in L4-L5 herniation reduction in the power of the extensor hallucis longus muscle and, in L5-S1 herniation, reduction of the achilles tendon reflex.

We analyzed these common neurologic signs in patients with lumbar disc herniation preoperatively and sequentially during 2 years after the operation, with reference to incidence and recovery of reflex/EHL-power disturbances and, in particular, the relation to the result of surgery.

Patients and methods

165 consecutive patients (72 women) with a lumbar disc herniation verified by myelography and/or CT and/or MRI and scheduled for surgical treatment, were included in a prospective study. The mean age was 42 (20–81) years. Patients showing signs of cauda equina compression were operated on as emergency cases, patients with progressive paresis or intractable pain were operated on semi-acutely while, for most patients, operative intervention was delayed for a minimum of 2 months from onset of symptoms, and was preceded by alternative treatments such as bed rest, corset and physical therapy. The median duration of sciatic pain was 5 (1–60) months. The level of disc herniation was conventional, with 95% occurring at the L4-L5 and L5-S1 levels. The surgical procedure consisted of open (microscopic or conventional) disc excision without fusion. No percutaneous discectomies were included, all herniations were thus surgically verified.

The clinical investigation was carried out, according to a protocol (Strömqvist and Jönsson 1993) and was performed prior to the operation and 4, 12, and 24 months postoperatively. Most clinical investigations were performed by 1 of the authors (BJ) and in the remaining cases by 1 of 6 specially interested spinal surgeons. The investigation included the straight leg raising test, crossed straight leg raising test, the knee and ankle jerks and the extension power of the big toe, tested in supine position, and sensibility in the lower extremities. Tendon reflexes and power of the extensor hallucis longus muscle at the neurological

Table 1. Prevalence of reflex/EHL disturbance (%) related to preoperative duration of sciatica (months)

	Preoperative duration of sciatica months				
	0–1	2–3	4–6	7–12	>12
Percentage of patients with neurologic disturbance	78	76	73	58	55

Table 2. Neurologic disturbance (%) related to the result of the preoperative straight leg raising (SLR) test

	Preoperative SLR-test			
	Pos 0–30°	Pos 30–60°	Pos >60°	Neg
Percentage of patients with neurologic disturbance	77	71	64	29

examination were recorded as normal, reduced or absent. A number of parameters describing the patient's pain were recorded. The patient's opinion on the effect of surgical intervention on the sciatic pain was evaluated on a 4-grade scale: excellent (almost or totally pain-free), fair (improved), unchanged and worse.

The results of the postoperative neurological examinations were compared to the preoperative findings and the difference was classified into 1 of 4 categories:

1. Improved (i.e., a reduced reflex/EHL power preoperatively was normal at follow-up or an absent reflex/EHL power preoperatively was reduced or normal at follow-up).
2. Unchanged normal.
3. Unchanged deficitent.
4. Deteriorated.

Statistical analysis was performed by chi-square analysis.

Results

During the follow-up, 14 patients underwent further lumbar spine procedures (repeat disc surgery, fusion a.s.o.) and 1 patient died. These patients were excluded from the follow-up study. At the 4-month follow-up, there were 6 missing values, at 12 months 0 and at 24 months 6 as regards the neurological examinations.

Preoperative neurologic deficit

Preoperative reflex/EHL-power reduction was seen in 69% (103/150) of the patients, and sensory disturbances in 62% (93/150). Neurologic disturbances were more common regarding the S 1 than the L IV and the L V nerve root; 3/6 of the patients with an L3-L4 herniation had reduction of the patellar tendon reflex, 44/67 of the patients with L4-L5 herniation had reduction of EHL power, while in patients with a lumbosacral herniation the achilles tendon reflex was reduced in 56/77 of the patients.

Patients with a preoperative duration of sciatica of less than 6 months more often had neurological disturbances ($p = 0.01$) (Table 1).

Patients with a positive SLR-test more often had reflex/EHL power disturbance as well as a sensory deficit and the frequency of reflex/EHL power disturbance increased with the severity of restriction in the SLR-test (Table 2). There was a correlation between a positive SLR-test and the occurrence of a reflex/EHL power disturbance ($p = 0.001$). No correlation was seen between a deficit and age or sex of the patient.

Postoperative recovery of neurologic signs

Of the 103 patients with neurological disturbances preoperatively, improvement compared to preoperative findings was seen in 45/99 at the 4-month follow-up, in 61/103 at the 1-year and 63/100 at the 2-year follow-up. Recovery differed somewhat at different levels; at the 2-year follow-up, improvement was found in 2/3 at the L3-L4 level, in 34/43 at the L4-L5 level and in 27/54 at the L5-S1 level.

Recovery was seen more often in patients with a preoperative symptom duration of less than 1 year. There was no correlation between neurologic recovery and age, sex or type of disc herniation.

Of the 93 patients with sensory changes preoperatively, normalization was noted in 31/88 at the 4-month follow-up, 35/93 at the 1-year and 36/89 at the 2-year follow-up.

2-year outcome related to neurological signs

The most favorable surgical outcome was seen in the 63 patients with neurological improvement: 56 reported an excellent result, 5 a fair result and 2 had unchanged sciatic pain at the 2-year follow-up.

Patients without deficit at the pre- and postoperative examinations and patients with unchanged neurological disturbance had similar outcomes. Patients with deteriorated neurological findings had the least favorable results (Table 3).

There was a correlation between excellent outcome and neurological recovery ($p = 0.02$).

Table 3. 2-year outcome (%, actual numbers within brackets) concerning sciatic pain related to neurological findings at 2-year follow-up, compared to preoperatively

	2-year outcome, sciatic pain			
	Excellent	Fair	Unchanged	Worse
Improved (n 63)	89 (56)	8 (5)	3 (2)	0
Unchanged (normal) (n 36)	75 (27)	14 (5)	8 (3)	3 (1)
Unchanged (deficit) (n 40)	70 (28)	10 (4)	20 (8)	0
Deteriorated (n 5)	60 (3)	20 (1)	20 (1)	0

Discussion

In most larger previous investigations of disc herniations, the incidence of preoperative neurological conditions, as determined by investigation of motor power and reflexes as well as sensibility, is between 50% and 90% (Knutsson 1961, Spangfort 1972, Hilding 1984, Jönsson &Strömqvist 1993).These figures correspond well to the 69% of reflex/motor and 62% of sensory disturbances in our series.

In our study, the patellar tendon reflex recovered in 67% and the achilles tendon reflex in 50%. Corresponding figures in a study by Blaauw et al. (1988) were 65% and 57%, respectively. These authors also noted a persisting sensory change in one third of the patients, but did not relate the surgical results to the neurological recovery. According to Knutsson (1962), 76% of patients with reduced power of the extensor hallucis longus muscle were normalized 1 year postoperatively; of the patients with paralysis, 7/13 had improved. Similar figures were reported in a recent study (Eysel et al. 1994); the recovery in patients with a less severe paresis was 70%, compared to 40% in patients with a more severe paresis.

The inverse correlation between neurologic disturbance and preoperative duration of radicular pain probably reflects the fact that perforated herniations cause more pain and reflex/motor disturbances and are operated on earlier than contained herniations (Jönsson and Strömqvist 1996).

The positive correlation between postoperative neurologic improvement and a good surgical outcome must be interpreted as an effect of successful root decompression. The fact that neurological deficit may persist in patients with a good outcome corresponds well to previous electromyographic investigations (Knutsson 1961), and might be related to intraneural damage. Previously, better surgical results have been described in patients with neurological deficits (sensory and motor weakness but not reflex asymmetry) preoperatively (Herron and Turner 1985) whereas no such correlation was seen in our series; patients without a preoperative neurological deficit fared as well as those with it in the postoperative course regarding pain relief. The inferior results in patients without neurological deficits previously demonstrated may reflect patients with negative explorations or with minor disc disease in eras of less precise neuroradiological techniques. In our series, however, the diagnosis in most cases was established by CT or MRI and was also verified peroperatively. In the presence of objective radiologic morphological findings and pain distribution in the adequate segment, absence of neurological deficits is not a contraindication for surgery. The correlation between a short history of symptoms and an improved neurological status postoperatively is not surprising, while the absence of correlation to patient age may be more surprising. Eysel et al. (1994) reported similar results, but with no difference in recovery related to age.

It has been demonstrated that the reflexes may vary during the day and in different positions. Such effects may have affected our study, but because of the size of the material can probably be disregarded. The dorsiflexion power of the big toe may be reduced not only due to nerve root affliction but also to pain inhibition which might explain the higher number of neurological recoveries in L 4-L5 disc herniations as compared to the level above and below. In Knutsson's study of postoperative EMG changes, however, 13% of patients with disc herniation at the L4-L5 level had persistent changes one year postoperatively compared to 2.3% of patients with disc herniation at the L5-S1 level.

The postoperative improvement in neurological findings occurred mainly within the first 4 months, but also to some extent up to 1 year. Between the 1-year and 2-year follow-up, only marginal improvement was recorded. Lewis et al. (1987) reported the same; in their study of 100 patients operated on because of disc herniation, a unilateral reduction of the ankle reflex was noted in 40% preoperatively, in 19.3% at 1-month follow-up and in 14.3% at 1-year follow-up. These figures may be interpreted as an ef-

fect of the surgical nerve root release. The role of non-surgical treatment of lumbar disc herniation is still debated and a number of studies have demonstrated favorable results concerning pain reduction (Weber 1983, Saal and Saal 1989, Saal et al. 1990). Radiographic studies have demonstrated a spontaneous resolution of disc herniations (Bush et al. 1992). Weber (1975) has studied the effect of delayed disc surgery on muscular paresis and concluded that "... the prognosis of the disturbed motor function in sciatica is not better after delayed surgical therapy than after conservative treatment during the first year of observation". The neurological recovery concerning tendon reflexes, however, has not been described in these reports on non-surgical treatment. Neurological improvement after chemonucleolysis has also been reported (Javid 1995).

The result of lumbar disc herniation surgery is influenced by a number of non-surgical factors, such as compensation claims and psychosocial factors (Hurme and Alaranta 1987). The results of the postoperative neurological examinations demonstrate a correlation between improved nerve root function and abolition of radicular pain.

In terms of compensational claims, it may be of interest to consider the neurophysiological correlation between pain and nerve root function. Is it possible to obtain improved function, as determined by examination of tendon reflexes and/or power of the EHL muscle, in combination with a leg pain of radicular origin?

Since an absent or reduced tendon reflex per se is asymptomatic, in contrast to an EHL or sensory condition, the various neurologic deficits described in this study have various implications for the patient. These implications, however, were not the aim of the study, which merely demonstrates that a careful pre- and postoperative neurologic examination in lumbar disc herniation has a diagnostic and prognostic value that should not be underestimated.

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