Microsurgical reoperation following lumbar disc surgery

Timing, surgical findings, and outcome in 92 patients

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Ninety-two patients who underwent microsurgical reoperation for persistent or new complaints following initial lumbar intervertebral disc surgery were evaluated retrospectively. Sixty percent of all pain relapses occurred within 1 year following the first operation; thereafter, the probability of a relapse declined steadily and was as low as 0.1% per year between 5 and 20 years. The results of microsurgical reoperation in terms of pain relief and working capability were considered "excellent" in 22% of patients, "good" in 30%, and "satisfactory" in 29%. Thus, 81% of the patients could be considered as treated successfully and in 19% the result was not successful.

The most common intraoperative findings were: a true recurrence at the same level in 43% of cases, a new herniation at another level in 15%, and a small recurrent fragment embedded in epidural fibrosis in 23%. Five percent of patients had severe epidural fibrosis as the only pathology. In 15%, reoperation was performed within 1 month to treat persisting pain, and either a missed disc fragment, an inadequately decompressed lateral recess, or an unrecognized second-level disc protrusion was found.

The clinical outcome is affected predominantly by the intraoperative pathology and the time interval between the first and second operation. An excellent or good outcome was usually achieved in patients with a recurrence of pain after 1 year resulting from a true recurrent disc or a new herniation at another level. In contrast, very unfavorable results were noted with most reoperations performed during the 1st year when extensive epidural fibrosis (or fibrosis with a small recurrence) was present.

KEY WORDS
- intervertebral disc herniation
- herniated nucleus pulposus
- lumbar surgery
- discectomy
- prognosis

RESULTS of surgery for herniated lumbar (intervertebral) disc, in terms of pain relief and capacity to work, are good in 80% to 95% of cases. A certain number of patients, however, have persistent radicular symptoms and pain following surgery, and some of them require early reoperation for various reasons. In addition, about 4% to 7% of the total group develop new complaints after a pain-free interval and undergo repeat surgery for recurrent nerve root compression.

It seems reasonable to apply a microsurgical technique in such cases, where meticulous dissection of the root, adhesions, and scar tissue is necessary. Recent results suggest that microsurgical techniques in primary disc surgery offer many advantages and improve the overall operative results. During a 5-year period, we treated 92 patients with repeat surgery for lumbar disc pathology, all with microsurgical technique. The aim of this study was to evaluate the results of the second intervention and to analyze the factors affecting the prognosis in these patients.

Summary of Cases

Patient Population and Analytical Method

Ninety-two consecutive patients with persistent or new complaints following their initial lumbar disc operation and a second microsurgical approach performed between 1979 and 1983 were included in this retrospective study. Prior to the second intervention, all patients had a neurological examination and either myelography or lumbar spine computerized tomography (CT), or both. The radiological findings included a missed disc fragment, recurrent herniation, new herniation at another level, scar formation, or spinal stenosis. At follow-up evaluation, the patients were examined neurologi-


gically by one of us (H.K.) and answered a questionnaire concerning their pain and working capability. The follow-up period after the second operation ranged from 6 months to 6 years (mean 2.6 years).

In order to analyze some of the factors affecting the prognosis, the outcome was related to the various intraoperative pathological findings as well as to the time interval between the first operation and the onset of new symptoms. For this reason, the patients were subdivided in three groups. Group A included patients who had no or unsatisfactory pain relief after their initial lumbar disc operation, with the reoperation accomplished within 1 month (13 cases). Group B included patients who suffered new radicular symptoms after a time interval of 1 to 12 months, and all underwent reoperation within the 1st year (43 cases). Group C included patients who had a pain-free interval of at least 1 year, then suffered new radicular symptoms and underwent reoperation between 1 and 20 years after the initial surgery (36 cases). The results were compared statistically by standard methods of chi-square analysis.

### Results

**Patient Data at First Operation**

Of the 92 patients, 72% were male and 28% were female. Most patients were between 40 and 50 years of age (range 21 to 82 years). Prior to the first operation, 38% of the patients performed heavy work and 52% light physical work, 5% were unemployed, and 5% were recipients of a pension. The first operation was performed in different hospitals; about one-half of the patients were operated on microsurgically and the other half with a conventional technique. After the initial lumbar disc operation, 34% of the patients returned to their previous working capability, 27% had a slightly reduced working capacity, 19% were only partially able to work, and 20% were unable to work between operations.

**Interval Between First and Second Operation**

Fourteen patients (15%) had no pain relief after the first operation. In 16 patients (17%) the pain recurred within the 1st month (mostly in association with forced physiotherapy), in 21% between the 2nd and 6th month, and in 9% between the 7th and 12th month. In summary, 60% of the patients suffered their pain relapse within 1 year and 85% within 5 years. Thereafter, the probability of a pain relapse decreased considerably. Figure 1 summarizes the time interval between the first and second operation in these patients.

**Patient Data at Second Operation**

In all patients, the clinical diagnosis of the affected nerve root (pain radiation, motor and sensory deficits, reflex disturbance) was supplemented by a repeat CT scan, a myelogram, or both. Table 1 shows the extent of surgery at the first and second operation. The number of hemilaminectomies, bisegmental fenestrations, and to some extent bisegmental discectomies was higher at the second operation. Obviously, there was a tendency to explore two neighboring levels if the clinical and radiological findings did not delineate a clear result.

The number of operations at the L5–S1 level decreased from 42% at the first operation to 27% at the second, while those at the L4–5 level increased from 52% to 62% and those at the L3–4 level increased from...
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### TABLE 3
Comparison of outcome of first and second microsurgical lumbar disc operation

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Definition</th>
<th>1st Op (495 cases)</th>
<th>2nd Op (92 cases)</th>
</tr>
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<tbody>
<tr>
<td>excellent</td>
<td>full working capability in previous or comparable activity; no or only occasional mild residual pain</td>
<td>39%</td>
<td>22%</td>
</tr>
<tr>
<td>good</td>
<td>full working capability in previous or comparable activity; mild residual low-back or radicular pain</td>
<td>34%</td>
<td>30%</td>
</tr>
<tr>
<td>satisfactory</td>
<td>reduced working capability; low-back and radicular pain improved; occasional analgesics</td>
<td>19%</td>
<td>29%</td>
</tr>
<tr>
<td>total successful operations</td>
<td></td>
<td>92%</td>
<td>81%</td>
</tr>
<tr>
<td>moderate</td>
<td>unable to resume work; low-back &amp; radicular pain improved; requires analgesics</td>
<td>6%</td>
<td>9%</td>
</tr>
<tr>
<td>poor</td>
<td>unable to work; pain unchanged or worse; requires regular analgesics</td>
<td>2%</td>
<td>10%</td>
</tr>
<tr>
<td>total unsuccessful operations</td>
<td></td>
<td>8%</td>
<td>19%</td>
</tr>
</tbody>
</table>

* Data of the results of the 1st lumbar disc operation are derived from Ebeling, et al.11

Results of Second Operation

**Pain.** Following the second operation complete pain relief or only occasional slight lumbar discomfort was reported by 52% of the patients; 24% frequently suffered back pain and only rarely noted sciatica; and 14% had persistent low-back pain or sciatica, but were slightly improved and did not need analgesics. In 10% of the patients the pain remained unchanged and severe, regularly requiring analgesics.

**Working Capability.** Since many of the patients were not in a professional employment (housewives, unemployed, pensioners) we used the term “working capability” to describe the postoperative physical situation (Table 3). Following the second operation 75 patients (81%) were able to resume their previous working capability with or without some degree of restriction. Seventeen patients (19%) were not able to work due to their considerable physical complaints.

**Motor and Sensory Deficits.** Following the second operation the number of patients with paresis diminished significantly (Table 4). Also, the number of pa-

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3% to 11%. Table 2 summarizes the intraoperative findings at the second procedure. Of the 13 patients without pain relief following the first operation, a missed disc fragment was found in five, an inadequately de-compressed lateral recess stenosis in two, and an unrecognized disc herniation at a second level in two; in the four other patients no pathological finding other than swelling and hyperemia of the root could be disclosed. In the group of patients with true recurrent sciatica the most frequent cause was a recurrent disc herniation at the same level, either ipsilateral or contralateral. Next to this in frequency was a small recurrent fragment embedded in epidural fibrotic tissue. Since the nerve root was immobilized by this fibrotic tissue, the root was sometimes pinched even by very small fragments (Fig. 2). New herniations at another level were found in 15%, while epidural fibrosis was the only cause found in 5%.

Complications arising at the second operation included a minor tear of the dura without damage to the nerve root during manipulation of the scar tissue in seven patients. Two patients later developed intravertebral discitis, two an epifascial infection, and one patient suffered a severe pulmonary embolism.

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![Fig. 2. Schematic representation of the effect of a small herniation on the nerve root embedded in epidural scar formation.](image-url)
tients with a sensory deficit, especially severe hypesthesia, was reduced by the second operation. The number of patients with a partial or complete cauda syndrome remained unchanged.

Classification of Second Operation Results. For assessing the results of the second operation, pain relief and capability to work were used as the two most important criteria. The results were classified in five categories (Table 3), as described previously. According to these rating criteria, 22% of the patients had an excellent result, 30% had a good result, and 29% had a satisfactory result. Thus, in total, the reoperation was successful in 81%. On the other hand, the outcome was unsuccessful in 17 patients (19%): eight considered their status as moderate or tolerable and nine as poor (Table 3). All patients were asked whether they would again decide in favor of a second operation, considering their result; 85% of the patients answered positively, while 11% would not give consent and 4% patients had no clear opinion.

Factors Affecting Prognosis

The reasons for reoperation at the different time intervals after the first discectomy are presented in Table 5. Of the 13 patients in Group A, the first operation may be considered inadequate in nine, while in four patients only swelling and hyperemia of the nerve root were found. The percentages of true recurrences and new herniations at another level were lower in Group B than in Group C; however, Group B contains more patients with epidural fibrosis and fibrosis plus a small recurrence.

Time Interval of Reoperation. If the final outcome is compared in the three time interval groups, it is evident that Group C patients have an outcome absolutely comparable to a first microdiscectomy with about 90% successful results (Fig. 3). Also, the outcome ratings are similarly distributed. Markedly less successful results are found in Group A, and the worst results with a very low number of excellent and good outcomes and a large number of satisfactory, moderate, and poor results are found in Group B. The differences in distribution between Groups B and C are significant (p < 0.005).

Intraoperative Findings. Based on the above results, we investigated whether these remarkable differences in outcome may be a consequence of the varying distribution of etiology in the three patient groups. Therefore, the outcome was related to the various etiologies, independent of the groups (Fig. 4). Unequivocally, the best results were obtained in patients with either a new herniation at another level or with a true recurrence. The outcome was unfavorable in patients with severe epidural fibrosis or fibrotic recurrent fragments. A statistically significant difference between the intraoperative findings was exhibited (p < 0.005).

Discussion

The advantages of the microsurgical technique for lumbar disc surgery have been reviewed previously. Since 1979, microsurgical techniques have also been used in recurrent disc herniations and results appear to be similar to those in primary discectomies. The refined instruments and the magnified vision under the operating microscope allow a careful dissection of the nerve root and dura and are very helpful for the detection of displaced small fragments. This is particularly true in cases with adhesions and severe epidural fibrosis, where identification of the various structures is sometimes very difficult. Complications such as injuries to the dura occurred at a slightly higher frequency but the incidence of nerve lesions was as low as in a primary microsurgical discectomy.

During recent years, several papers have described the intraoperative pathology at reoperation following lumbar discectomy. The incidence of true

### TABLE 5

Intraoperative findings and time course of the complaints after first lumbar disc operation*

<table>
<thead>
<tr>
<th>Intraoperative Findings</th>
<th>Group A (13 cases)</th>
<th>Group B (43 cases)</th>
<th>Group C (36 cases)</th>
</tr>
</thead>
<tbody>
<tr>
<td>inadequate first operation</td>
<td>9 (71%)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>true recurrence</td>
<td>0</td>
<td>20 (46%)</td>
<td>22 (61%)</td>
</tr>
<tr>
<td>new herniation</td>
<td>0</td>
<td>7 (16%)</td>
<td>7 (19%)</td>
</tr>
<tr>
<td>small recurrence &amp; fibrosis</td>
<td>0</td>
<td>13 (30%)</td>
<td>9 (24%)</td>
</tr>
<tr>
<td>epidural fibrosis</td>
<td>0</td>
<td>4 (9%)</td>
<td>1 (3%)</td>
</tr>
<tr>
<td>no pathological finding (swelling &amp; hyperemia)</td>
<td>4 (29%)</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

* The sum of intraoperative findings amounts to more than 92, due to bisegmental operations. Groups A underwent repeat surgery < 1 month after initial surgery, Group B 1 to 12 months after, and Group C 1 to 20 years after.

FIG. 3. Outcome related to time interval between the first surgery and reoperation. For a description of Groups A, B, and C see text and for a description of the outcome ratings see Table 3.
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Recurrent disc herniation varies between 20% and 60% in most series, which is in line with 46% in the present results. A new disc herniation at another level has been reported in 19% of cases and amounted to 15% in this series. Severe epidural fibrosis has been observed in 20% to 40% of cases, which is in agreement with the 29% in our series if the cases with a small recurrence plus fibrosis are included. A so-called “inadequate” first operation has been described in 6% to 13% of cases and occurred in 11% of our cases. Lateral recess stenosis as a cause of new complaints was rare in the present series but has been reported as frequent as 20% in some publications.

If the outcome of reoperation is compared with the outcome of a first microdiscectomy, certain differences become evident. The number of successful results decreased from 92% to 81% and the number of failures increased from 8% to 19%. In addition, there was a shift from excellent to satisfactory results, denoting more patients with a reduced working capability and frequent back pain and sciatica. This increase of satisfactory and unsuccessful results cannot be explained by a persisting severe motor or sensory deficit (Table 4) but rather by less successful relief of pain. After the first microdiscectomy, complete or significant pain relief was obtained in 87% to 91% of the patients in contrast to only 52% following reoperation. It seems that the outcome parallels closely the pain relief results. This leads to the important question, why surgery was not successful in nearly 20% of our cases, a figure which is in line with data from other publications.

The frequency of two-level exploration and of bisegmental discectomies was markedly higher in second interventions (Table 1). We think that some of these two-level explorations might have been avoided if an accurate CT study with 1.5-mm slices had been available in such cases. For a description of outcome ratings see Table 3.

A complete laminectomy was not necessary in this series, but hemilaminectomy was used in 18% of the cases at reoperation. With more experience, we now consider most of the hemilaminectomies unnecessary. Every surgeon is sometimes in the situation where more bone removal of the upper or lower lamina is necessary, as in the case of a fragment that has slipped far upward or downward. In such a situation, an additional section of the ligamentum flavum at the adjacent level will provide adequate access to the hidden fragment and is preferable to a hemilaminectomy. A hemilaminectomy in combination with a bisegmental discectomy may create the risk of a new disease, instability of a motion segment, and/or a facet arthropathy.

Very important factors affecting the prognosis of a reoperation obviously are the pain-free interval after the first operation as well as the intraoperative pathology. Patients with a good outcome following the first operation who developed new radicular symptoms on the ipsi- or contralateral side with a well-matching CT finding after an interval of 1 year or more had the same probability of having a favorable outcome as at the first discectomy (Fig. 3). Excellent, good, and satisfactory results were obtained in 36%, 36%, and 23%, respectively. The majority of these patients (80%) presented with a true recurrent herniation (on the same or opposite side) of the previously operated disc or a new herniation at another level (Table 5). In this group (Group C) the neuroradiological diagnosis was clear and a monosegmental approach could be used as in the first discectomy. Extensive epidural fibrosis was rare in this group, however, some of these patients had a true but small recurrent fragment embedded in epidural fibrosis.

The prognosis for these two pathologies (epidural fibrosis and a small fragment), which occurred more frequently in Group B (Table 5), is unfavorable (Fig. 4) and explains at least partially the less successful outcome in Group B. These patients all had their pain relapse between the 2nd and 12th month after the first discectomy. A pain-free interval of less than 12 months after the initial lumbar disc operation and a slow onset of new complaints are assumed to be characteristic for an epidural fibrosis with nerve compression.

High-resolution CT scans with reformatting as well as intravenous administration of contrast material in most cases allows differentiation of contrast-enhancing fibrotic tissue from the nonenhancing disc fragment and especially from a true recurrence or a new herniation. This differentiation of fibrosis from other pathologies is important in avoiding unnecessary two-level explorations, which were most frequent in Group B as a result of clinical and myelographic uncertainty as to the affected root and level.

The organic pathology of epidural fibrosis plus a small recurrent disc fragment deserves further discussion. During microdissection, a small fragment is usually found to have slipped out of the anulus fibrosus at the previous fenestration. Since the nerve root and the
Dura are immobilized by the epidural scar tissue, the pressure is exerted directly upon the nerve root (Fig. 2). It seems that in such cases a certain amount of scar already exists without harming the nerve root, and pain occurs only following the protrusion of the small disc fragment. The question may be raised why epidural fibrosis becomes the primary organic pathology in other patients. There obviously is a continuous transition between nonharmful and harmful fibrosis, which is supported by the present findings. All patients with extensive fibrosis, but only one-third of those with some fibrosis and an additional small recurrent disc fragment, had a poor outcome. It is obvious that in these cases the tendency for scar formation is the decisive factor for the prognosis. Following surgery, the local amount of blood accumulation in proximity with the dura and nerve root promotes fibroblast proliferation and finally the extent of epidural scar formation. Very extensive epidural fibrosis is capable of producing fixation of neural elements and, in some cases, actually compresses them.\(^9\)\(^{10}\) Such patients usually show remarkable postsurgical improvement after careful microsurgical dissection, but in many cases the complaints and the scar formation recur after a certain amount of time. Some authors claim that the results may be improved if the residual dead space around the neural elements is filled with an autogenous full-thickness fat graft which seems to substantially reduce the formation of epidural fibrosis.\(^4\)\(^9\)\(^{29}\)\(^{33}\)\(^{40}\)\(^{42}\)

The patients in Group A underwent reoperation within the 1st month. All of the patients with a missed fragment, an inadequately decompressed lateral recess, or a misdiagnosed second-level disc prolapse had a successful outcome, in contrast to the patients where no pathological finding was disclosed during the reoperation. Retrospectively, these patients might have suffered some other (at this time not recognized) rare pathology such as extracanalicular disc herniation or a distant compression syndrome.

Other interesting facts became apparent in the analysis of our results. At the second operation the frequency of discectomies had increased at the L4–5 level and had remarkably decreased at the L5–S1 level. A compilation of cases from the literature essentially shows the same results (Fig. 5). Obviously, the risk of suffering a relapse at the level of the first operation is less frequent at L5–S1 than at L4–5 and L3–4. In addition, the increased number of discectomies at L4–5 and L3–4 can be explained only if one assumes that new herniations mostly occur at the level above the segment operated on at the first operation.\(^36\)\(^37\) This assumption is in line with the present findings. Of the 15 new herniations, 11 occurred at the level above the primary operation and 10 of these were found at L4–5. It seems that following discectomy the motion segment above is exposed to an amplified biomechanical stress leading to accelerated degenerative changes in this intervertebral disc.

Another interesting aspect is the time interval between the first and second operation (Fig. 1). Our findings clearly demonstrate that the recurrence rate is closely time-dependent. Nearly 60% of all reexplorations were performed within 1 year and about 85% within 5 years. The longest intervals observed in our series were 17 to 20 years. These data can be used to calculate approximately the risk or the probability of a recurrence in the total population of patients with a first discectomy. Assuming an average recurrence rate of about 7%,\(^15\)\(^{20}\)\(^{26}\)\(^{27}\)\(^{36}\)\(^{41}\)\(^{45}\)\(^{49}\)\(^{51}\)\(^{53}\)\(^{54}\) about half of this risk (3.5%) is concentrated in the 1st year. The probability for a recurrence decreases to about 0.6% per year between the 2nd and the 5th year and to about 0.1% during the following 10 years.

Most authors report the incidence of reoperations in series of discectomies as well as the average follow-up period. If these two figures are transferred into the

**TABLE 6**

*Actual and corrected rate of recurrence after discectomy*

<table>
<thead>
<tr>
<th>Authors &amp; Year</th>
<th>No. of Cases</th>
<th>Follow-Up Period (yrs)</th>
<th>Recurrence Rate (%)</th>
<th>Corrected Recurrence Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mattmann, 1969</td>
<td>2643</td>
<td>12</td>
<td>7.5</td>
<td>7.8</td>
</tr>
<tr>
<td>Schramm, et al., 1978</td>
<td>3238</td>
<td>4</td>
<td>6.4</td>
<td>8.0</td>
</tr>
<tr>
<td>Menge, et al., 1980</td>
<td>405</td>
<td>8</td>
<td>9.0</td>
<td>10.6</td>
</tr>
<tr>
<td>Williams, 1978</td>
<td>530</td>
<td>5.5</td>
<td>9.1</td>
<td>10.5</td>
</tr>
<tr>
<td>Goald, 1981</td>
<td>477</td>
<td>1</td>
<td>4.0</td>
<td>8.0</td>
</tr>
<tr>
<td>Ebeling, et al., 1986</td>
<td>485</td>
<td>3</td>
<td>5.5</td>
<td>7.3</td>
</tr>
</tbody>
</table>

*For details see text.*
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cordinates of the above curve, the presumptive recurrence rate can be estimated on a 20-year basis (Table 6). This allows a more objective comparison of the various reports and a critical revision of the question of recurrences following lumbar discectomy. According to Table 6, the recurrence rate on a 20-year basis would be in the order of 8% to 11%. To construct this curve with more accuracy, it is important to collect more data.

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