

Primary and revision lumbar discectomy

A 16-YEAR REVIEW FROM ONE CENTRE

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We present a review of 553 patients who underwent surgery for intractable sciatica ascribed to prolapsed lumbar intervertebral disc. One surgeon in one institution undertook or supervised all the operations over a period of 16 years.

The total number of primary discectomies included in the study was 531, of which 42 subsequently required a second operation for recurrent sciatica, giving a revision rate of 7.9%. Factors associated with reoperation were analysed. A contained disc protrusion was almost three times more likely to need revision surgery, compared with extruded or sequestered discs. Patients with primary protrusions had a significantly greater straight-leg raise and reduced incidence of positive neurological findings compared with those with extruded or sequestered discs. These patients should therefore be selected out clinically and treated by a more enthusiastic conservative programme, since they are three times more likely to require revision surgery.

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The surgical management of prolapse of a lumbar disc has been practised since Mixter and Barr¹ discovered the link between sciatica and herniation of a lumbar disc in 1934. Discectomy through a limited laminotomy remains the most common approach for this condition in which conservative management has failed. Primary discectomy gives good results, but for revision surgery these results are less certain

and the risks greater.²⁻⁴ Many studies have looked at rates of recurrence which are reported to vary from 3% to 19%.^{3,5-11} In this study we have examined the rate of recurrence, and also identified the risk factors which would indicate the likelihood of a revision operation being required.

Patients and Methods

We identified patients who underwent either primary or revision discectomy at levels L4/5 and L5/S1 between 1986 and 2001. Radicular symptoms had to have been present for a minimum of six weeks, and all operations had to have been carried out by or under the supervision of one surgeon (SME). All patients had to have suffered from intractable leg pain associated with positive physical findings without response to conservative treatment. All patients had signs of nerve entrapment and correlating neurodiagnostic investigations such as CT, with or without myelography, or MRI. The minimum follow-up was one year; the maximum was just over 16 years. Patients presenting with a prolapse at levels other than L4 to S1 and those with a cauda equina syndrome were excluded from the study.

All operations followed a standard pattern. The patient was placed prone on the operating table with hips and knees flexed in the 90°/90° position. The level to be explored was confirmed on radiographs, before and during surgery. After making a standard midline incision centred over the appropriate interspace, the interlaminar space was identified and the ligamentum flavum excised. Dissection was extended into the laminae, as required, until the dural sac and nerve root could be retracted medially to expose the disc. In the case of protruded discs, a square annulectomy was made with a No 15 blade and disc material was removed. A microscope was used in fewer than 5% of patients. Parameters such as gender, age, level and side of discectomy were entered into a database for analysis together with diagnostic and clinical parameters. These included the angle of the straight-leg raise recorded in degrees and the presence or absence of a neurological deficit (altered sensation, reduced motor power and absent or diminished reflexes).

The type of disc prolapse revealed at operation was recorded. A protrusion was identified as a bulge of the nucleus with an intact outer layer of annulus. When the disc

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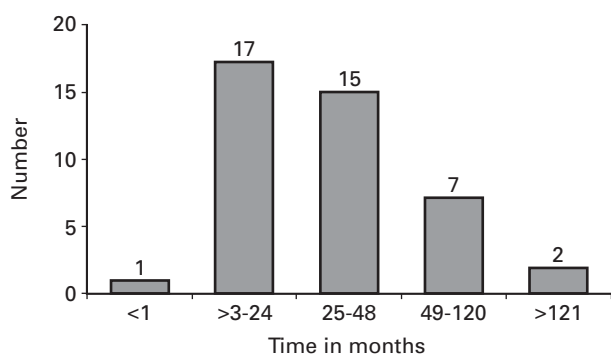


Fig. 1

Bar chart showing timings of recurrent disc herniations in 42 patients who had primary lumbar discectomy.

material penetrated through the ruptured annulus, but remained in continuity with the disc space, it was entered as an extrusion. Sequestration was said to be present when the disc material was found free in the canal, remote from the disc space. The rate of recurrence was also reviewed. A disc herniation at the same level and the same side was regarded as a recurrence.

Statistical analysis. The association between binary outcomes, complications, neurological findings, type of disc prolapse and whether or not a revision had been undertaken was determined using logistic regression, each association being corrected for age and gender. An odds ratio was obtained for each association as a measure of risk due to the presence of a predictor. The association with the angle of straight-leg raise and the type of disc prolapse, again corrected for age and gender, was analysed by multiple regression. The dependence of time to revision on the type of prolapse, again corrected for age and gender was analysed by Cox's proportional hazard model. Forward stepwise routines were used to choose the best set of predictors of outcome in all patients. The programme NCSS97 (NCSS, Kaysville, Utah) was used for analysis.

Results

There were 553 patients in the study. Of these, seven had an operation at two levels, 25 had had a primary operation elsewhere and were therefore excluded; four sets of notes were lost. The total number of primary operations analysed was 531, of which 42 subsequently required a second operation, a revision rate of 7.9% (Fig. 1). The mean interval between primary discectomy and revision was seven years (1 to 16.5).

Type of disc herniation. There were 341 protrusions (64.2%), 87 extrusions (16.4%) and 103 sequestrations (19.4%). Of the 42 revisions, 34 were protrusions, two extrusions and six sequestrations. Therefore, a patient presenting with a primary protrusion was at significant risk of developing a recurrent lesion ($p < 0.018$) compared with

patients with sequestered or extruded discs. Using a logistic regression model, the odds ratio (OR) for disc protrusion was 2.60, i.e. the likelihood of a patient with a primary disc protrusion requiring revision surgery was increased by a factor of 2.60 compared with that for extrusion (OR = 0.23) or sequestration (OR = 0.65). The type of disc lesion was analysed using Cox's proportional hazards to determine if the time to the revision was dependent on it. The hazard ratios for protrusions, extrusions and sequestrations were 2.42, 0.23 and 0.65, respectively, showing that primary disc protrusions were more likely to recur even when taking into account time, gender and age.

Gender and age. Of the 531 patients who underwent primary discectomy, 230 (43.3%) were women and 301 (56.7%) were men. Their mean age was 39.4 years (14 to 75). Of the 42 revision operations, 28 were in men (66.7%). Male gender was therefore, a risk factor, with an odds ratio of 1.69 ($p = 0.12$ not significant). The mean age of the patients who had revision was 36.7 years (17 to 57).

Level. Of the 531 primary discectomies, 309 (58.2%) were at the L5/S1 level and 222 (41.8%) at the L4/5 level. Of the 42 revisions, 31 (73.8%) were at the L5/S1 and 11 at the L4/5 (26.2%) level. More L5/S1 discs therefore required further surgery. The odds ratio of 1.96 signified that discs at the L5/S1 level were almost twice as likely to need revision surgery compared with those at the L4/5 level (corrected p value, 0.06).

Type of disc herniation, level and gender. Of the 341 primary protrusions, 202 (59.2%) were at L5/S1 and 139 (40.8%) at L4/5. Of the 87 primary extrusions, 51 (58.6%) were at L5/S1 and 36 (41.4%) at L4/5. Of the 103 primary sequestrations, 56 (54.4%) were at L5/S1 and 47 (45.6%) at L4/5. There was no association between the type of herniation and the level of herniation. Of the primary protrusions, 191 (56%) were in men and 150 (44%) in women. Of the primary extrusions, 54 (62.1%) were in men and 33 (37.9%) in women. Of the primary sequestrations, 56 (54.4%) were in men and 47 (45.6%) in women. There was no association between the type of herniation and gender.

Clinical presentation. The data on primary protrusions were analysed and compared with those on extrusions and sequestrations. Of patients with primary protrusions 118 (34.6%) had no neurological deficit on examination compared with 19 (21.8%) of primary extrusions and 23 (22.3%) of primary sequestrations. Patients with protrusions were more likely to have no neurological abnormality ($p = 0.0085$, OR = 0.58). The odds ratio for patients with extruded herniations was 1.42 and that for sequestered herniations was 1.62. The angle of the straight-leg raise in patients with protrusions was more likely to be high (i.e. unrestricted) compared with those with extruded or sequestered herniations ($p = 0.005$).

Complications of primary discectomies. There were 46 complications in the primary surgical group (531 operations). This gave a complication rate of 8.7%. Of the 46 complications, 29 were due to inadvertent perforation of the

Table I. The number and type of complications which occurred after 521 primary lumbar discectomies

Complication	Disc type			Total
	Protrusion	Extrusion	Sequestration	
Perforation of the dura	15	9	5	29
Pseudomeningocele	0	3	0	3
Neurological damage	1	0	1	2
Deep-vein thrombosis	1	0	1	2
Pulmonary embolism	0	1	1	2
Urinary tract infection	3	0	2	5
Urinary retention	0	1	0	1
Haematoma	0	0	1	1
Discitis	0	1	0	1

dura, indicated by the presence of free cerebrospinal fluid (CSF). The other 17 complications are listed in Table I. Both patients with neurological complications involved damage to nerve roots. No patient had a wound infection. Free CSF was observed in 15 patients in the primary protrusion group (4.4%), nine in the primary extrusion group (10.3%) and five in the primary sequestration group (4.9%), an overall incidence of 5.5%. Of these 29 patients, three (all in the primary protrusion group) required further surgery for pseudomeningoceles. Thus, 10.3% of patients in whom some form of dural tear had occurred formed a pseudomeningocele – an overall risk of 0.6%. Three patients in this group underwent some form of primary suturing of the defect in the dura which was not however, routine practice. Most tears were minor defects and were treated by a patch of fat or muscle or simply bed rest.

Complications of revision discectomies. There were eight (19.1%) complications in the revision group. Free CSF was observed in six patients (14.3%). The other two complications were a chest infection and a pseudomeningocele. Thus seven patients (16.7%) with a dural tear in the revision discectomy group, went on to form a pseudomeningocele, an overall incidence of 2.4%.

Revision discectomies. The mean time interval between the primary discectomy and the revision operation was three years (20 days to 13.6 years). Figure 1 shows the intervals of time at which recurrent herniations presented; 76% occurred between three and 48 months. The patient who underwent a revision on day 20 may perhaps be considered as a failure of primary surgery, but was included in the revision group. Of the 42 patients who required revision surgery, 32 had recurrence of disc material alone, four had a mixture of scar and disc material and six had only scar tissue at exploration. None of the last group of six patients had the benefit of contrast MRI.

Discussion

Our rate of revision surgery of 7.9% is similar to that described in the literature. An important influence on the rate of revision is the thoroughness of follow-up. Some of our patients may have been operated on elsewhere. We con-

sider this unlikely since our hospital is the tertiary referral centre for spinal disorders (including revision spine surgery) for the North West of England and North Wales. Two patients with recurrent sciatica returned to our centre more than 10 years after their original surgery.

Our meticulously observed incidence of even minor dural injury resulting in free CSF is 5.5% for primary and 14.3% for revision surgery. A search of the literature produced over 400 references to the complications of lumbar discectomy but few specified an incidence of CSF leak. Stolke, Sollman and Seifert¹² quoted an incidence of 1.8% in microdiscectomy and 5.3% in macrodiscectomy increasing to 17.4% in revision operations. Alexander et al¹³ reported an overall incidence of 4% of accidental durotomy for all types of lumbar surgery and Wang, Bohlman and Riew¹⁴ an incidence of 14%. We suggest that this is a consensus.

Our results have shown that primary protrusions are almost three times as likely to require revision surgery as primary extrusions or sequestrations. We suggest that this surprising finding could be explained on the basis that a protrusion represents the beginning of a process of serial fragmentation of disc material, whereas extrusion and sequestration are an end-stage of this process. Even though surgical treatment yields a satisfactory resolution of symptoms more quickly, the consequences of surgery, in terms of complications, must be carefully considered.^{2,5,11} The results of revision surgery are less predictable and the incidence of complications increased.

In evaluating our results, the natural history of the condition needs to be taken into account. Lumbar disc herniation shows a favourable response to conservative treatment even in the presence of some neurological deficit.^{10,15} Several studies have shown that most herniations resorb over time.^{6,15} If left untreated, they decrease in size independent of the type or size of the disc by a process of dehydration and phagocytosis.^{10,16} Thus it could be argued that patients with primary disc protrusions should initially receive an extensive period of conservative treatment, including repeated epidural infiltrations. To some extent patients with primary protrusions can be identified clinically. They are more likely to have unrestricted straight-leg raising and no neurological deficit.

However, a protracted conservative regimen in the presence of severe radicular symptoms should be avoided since this increases morbidity and reduces the chances of a successful outcome. A longer preoperative interval in patients with chronic sciatica was associated with a less predictable outcome.^{17,18}

We have identified factors which may help in selecting patients for a more enthusiastic non-surgical treatment in the first instance. A randomised, controlled trial (operative *versus* conservative treatment) of patients presenting with protrusions is needed in order to justify this proposal.

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