Microsurgical excision of lateral lumbar disc herniation through an interlaminar approach

F. Postacchini, G. Cinotti, S. Gumina
From the University of Rome ‘La Sapienza’, Italy

We made a prospective study of 43 consecutive patients treated for intraforaminal (34) or extraforaminal (9) herniations of a lumbar disc by excision through an interlaminar approach, using an operating microscope. The intraforaminal herniations were contained or extruded in 52% and sequestrated in 47%; for extraforaminal herniation the proportions were 66% and 33%, respectively. There was additional posterolateral protrusion or spinal stenosis at the level of the lateral herniation in seven and four cases, respectively. The patients were reviewed at three months and two years after surgery. Radiographs showed three grades of facetectomy: grade I, removal of 50% or less, grade II, excision of 51% to 75%, and grade III, subtotal or total facetectomy.

For intraforaminal herniations the results were excellent or good in 88% of patients when reviewed at three months and in 91% at two years. For extraforaminal herniations, there was an excellent or good outcome in 89% of patients in the short term and in all in the long term. The facetectomy had been grade I in 14 and grade II in 25; it had been grade III in four, but only one had had total facetectomy. No patient had developed vertebral hypermobility as a result of the operation.

An intralaminar approach using an operating microscope can provide adequate access to a lateral protrusion. It has the advantage of allowing the treatment of posterolateral protrusion or posterior annular bulge and of spinal stenosis at the same level.

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Lateral herniations of lumbar discs have been described as far lateral,1-4 extreme lateral,5-8 foraminal, intraforaminal or extraforaminal,9-14 and extracanalicular.15 The simple term ‘lateral’ has the advantage of including herniations both within and outside the intervertebral foramen. Most lateral herniations develop partly within and partly outside the foramen: we use ‘intraforaminal’ for those herniations with more than half of their transverse diameter within the tangent to the lateral border of the articular processes. Extraforaminal herniations have more than half of their transverse dimension lateral to the lateral border of the articular processes.

Myelography may occasionally show compression of a nerve root by an intraforaminal herniation,8,16 but all lateral herniations of the disc are best shown by CT and MRI. The use of these imaging techniques to demonstrate extraforaminal herniations has shown that 4% to 10% of all herniations of the lumbar discs are lateral.3,6,11,13,17,18 Until recently, the current method of surgical treatment of lateral herniations consisted of this excision through an interlaminar approach without any special visual aid. This may involve complete resection of a facet joint, either incidentally or intentionally.2,6 Complete unilateral facetectomy may cause instability and result in persistent low back pain after surgery,15,16 and therefore more recently, extravertebral approaches have been used. These include para-articular,14,15 paraspinual,1,2,23 and paralateral22 approaches which allow excision of the herniation without opening the spinal canal.1,23

More use is now made of operating microscopes and there are numerous studies of the results of microdiscectomy for herniations within the spinal canal. We know of no investigation of the role of microsurgery in lateral herniation of the disc by an interlaminar approach, and now report a prospective study of this method in such patients.

Patients and Methods

From 1991 to 1995, a total of 45 patients had microdiscectomy through an interlaminar approach for a lateral herniation of a lumbar disc, representing 12% of all such patients operated on in that period. Two patients were lost to follow-up.

The remaining 43, 27 men and 16 women, had a mean
age of 56 years (39 to 82). The most commonly involved level was L4-L5, followed by L3-L4 (Table I). The symptoms and signs were monoradicular in 37 and biradicular in six, and the preoperative diagnosis had been made by CT in 15, by MRI in 17, and by both in 11. Both methods had been used when the first did not allow a precise diagnosis, particularly of definition of the type of herniation as contained, extruded or sequestrated with a free fragment of disc in the intervertebral foramen. One patient with L2-L3 intraforaminal herniation had disco-CT after MRI.

The herniation was intraforaminal in 34 and extraforaminal in nine. In the intraforaminal herniations, imaging studies showed or suggested that the protrusion was contained or extruded in 18 and sequestrated in 16 (Table II). Of the nine extraforaminal herniations, four were contained and two were extruded; three were sequestrated and, in these, at least 60% of the fragment of disc was outside the intervertebral foramen on the CT or MRI scans in which the fragment showed the largest size.

In 13 patients, the disc related to an intraforaminal herniation and also had a posterior annular bulge (8) or a posterolateral protrusion (5). There was central or lateral stenosis at the same intervertebral level as the herniation or at adjacent levels in four patients. One of these had degenerative spondylolisthesis of the vertebra above the herniated disc, and another of the vertebrae above and below the herniation. In these patients, flexion-extension radiographs were also obtained before surgery.

**Operative technique.** All the operations were by the senior author (FP). A midline skin incision, 3 to 5 cm long, is used to expose the interlaminar space. The operating microscope is then used. In most cases, the excision of laminae is limited to the lower half of the proximal and the upper quarter or third of the lower lamina. The medial third or half of the articular processes is also excised. The intervertebral disc is exposed, and discectomy performed.

When preoperative imaging has shown an extruded or sequestrated intraforaminal or a sequestrated extraforaminal herniation, the operating microscope is tilted upwards to examine the inferolateral part of the posterior aspect of the upper vertebral body. An extruded herniation is seen as an abnormal prominence of disc tissue, just above the lower margin of the vertebral body, and is removed after the incision of the peripheral layers of the annulus fibrosus or fibrous sheath over the herniated tissue. Any free fragment of disc is grasped and removed when enough of it has been exposed. When no lesion is visible at this stage, the laminectomy is enlarged cranially and laterally with care to preserve some of the pars interarticularis. Eventually, the sequestrated disc tissue is visible, either caudal or ventral to the nerve root within the intervertebral foramen. When a large disc fragment is removed, no previous attempt is made to expose the nerve root, but a Frazier’s 90° angled probe is used to explore the intervertebral fora men ventrally to the root.

When imaging studies show or suggest the presence of a contained intraforaminal or a contained or extruded extraforaminal herniation, the lateral portion of the disc is excised using a reversed 45° angled pituitary rongeur (Fig. 1). Either before or after this, the lateral annulus fibrosus is ruptured with an angled probe where it protrudes into the intervertebral foramen. In most of these patients, a large amount of disc tissue can be removed from the lateral part of the disc, either in small pieces or as one large fragment. In patients with a preoperative diagnosis of intraforaminal herniation, when only a small amount of tissue is excised, further careful inspection of the inferolateral part of the posterior aspect of the upper vertebral body is performed to find any extruded fragments.

**Follow-up.** Patients were reviewed at 1, 3, 6 and 24 months.

| Table I. The number of lateral herniations of the disc related to lumbar levels |
|-----------------------------|-----------------------------|
| Number | Percentage |
| L2-L3 | 4 | 9.3 |
| L3-L4 | 12 | 27.9 |
| L4-L5 | 24 | 55.8 |
| L5-S1 | 3 | 6.9 |
| Total | 43 | 99.9 |

| Table II. Types of herniation in 34 patients with intraforaminal herniated disc |
|-----------------------------|-----------------------------|
| Imaging | Operative findings | Same | Different |
| Contained | 8 | 9 | 6 | 2 |
| Extruded | 10 | 10 | 7 | 3 |
| Sequestrated | 16 | 15 | 15 | 1 |

![Diagram to show method of excising an extraforaminal contained or extruded herniation through an interlaminar approach.](image-url)
The three-month evaluation was by an orthopaedic surgeon (SG) not involved in the treatment. The patients completed a questionnaire on residual pain, need for analgesics, function and degree of improvement after operation using visual analogue scales. Each of the four items was scored from 0 for worst to 30 for excellent, giving a total subjective score of up to 120. The examiner scored patients from 0 to 80 on objective findings of spinal range of movement, nerve-root tension tests, strength of leg muscles and skin sensation, ranging from 0 for severe signs to 80 for complete absence of pathological findings. The same observer carried out the latest follow-up evaluation using the same questionnaire and objective scoring, without knowledge of the previous results.

Both subjective and objective scores were taken into account for the outcome measure, giving the objective findings less weight than the patient’s satisfaction, which we believe reflects the quality of the result better. Halving the total gave a percentage result in which excellent scored 81 to 100, good 61 to 80, fair 41 to 60, and poor 40 and below.

All patients had a plain radiograph of the lumbar spine, usually at the one-month review, to determine how much of the articular processes had been excised by comparison of the operated with the opposite side. To quantify this, we measured the width of the lamina or the inferior articular process of the proximal vertebra at the level of the largest facetectomy and expressed the excision as a percentage of the width of the opposite lamina or articular process. Two measurements were made independently by two observers and the lowest value was accepted unless the difference exceeded 10%, when the third author then acted as referee. We recorded bone excision as: grade I, removal of 50% or less; grade II, 51% to 75%; and grade III, subtotal or total facetectomy.

Flexion-extension radiographs were taken at the three- or six-month review of all patients with grade-II or grade-III facetectomy, and of the two patients with preoperative degenerative spondylolisthesis, to detect any vertebral hypermobility at the operated level. In the patients with no preoperative spondylolisthesis, we recorded instability when there was sagittal translation of 4 mm or more, or angular movement of 10° or more. For the two patients with spondylolisthesis, we compared slipping on the postoperative radiographs with the preoperative state.

For the five patients (3 intraforaminal, 2 extraforaminal) who had MRI preoperatively, this investigation was repeated during the first two months after surgery.

We used the chi-squared test for statistical analysis.

Results

The mean operating time was 68 minutes (50 to 130) and no blood transfusion was needed. There were no intraoperative or postoperative complications. In one patient with L4-L5 herniation, two intervertebral levels were explored because the wrong level had initially been exposed. One patient with a sequestrated intraforaminal herniation at L3-L4 had an inadvertent total facetectomy and another had recurrence of disc herniation at three years after surgery. In the latter, the primary operation had been for an intraforaminal sequestrated herniation; at the second operation, an intraforaminal extruded herniation was excised from the same level on the same side.

The operative findings in intraforaminal herniations confirmed the preoperative diagnosis of the type of herniation as contained, extruded or sequestrated in 83% of cases (Table II). The best correlation between imaging and intraoperative diagnosis was for sequestrated fragments.

Three of the four patients with a preoperative diagnosis of contained extraforaminal herniation had a large amount of tissue removed from the lateral part of the disc, but little material was excised from the fourth. One of the patients diagnosed as having an extruded extraforaminal herniation had a large fragment removed from this region. All three patients with a preoperative diagnosis of sequestrated herniation had excision of a single free fragment or multiple fragments.

Six of the patients with intraforaminal herniation also showed mild or marked protrusion of the paramedian and/or the posterolateral disc and seven showed slight soft posterolateral bulging. Three of the patients with extraforaminal herniation also showed bulging of the involved disc in the posterolateral region. The time in hospital ranged from one to three days, with 72% staying for only one night after surgery.

Clinical. At three months, the result was excellent or good in 88% of patients with intraforaminal herniation (Table III). All those with a sequestrated disc had an excellent or good result, but three of the four with a fair or poor result had a contained herniation at operation (Table IV). This difference is statistically significant (p < 0.01). One patient in the contained group had persistent radicular pain which was only slightly less severe than that before surgery. Of

| Table III. Clinical results in lateral herniations at follow-up |
|------------------|------------------|
|                  | 3 months intraforaminal | 3 months extraforaminal | Latest intraforaminal | Latest extraforaminal |
| Result           |                  |                  |                  |                  |
| Excellent        | 19 | 5 | 23 | 6 |
| Good             | 11 | 3 | 8  | 3 |
| Fair             | 2  | 1 | 3  | - |
| Poor             | 2  | - | -  | - |

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the patients with extraforaminal herniation, 89% had a satisfactory result (Table III), and the patient with a fair result had only a small amount of disc material removed.

At the latest follow-up, the result for intraforaminal herniation was excellent or good in 31 (91%) and fair in three patients (Table III) including the patient with recurrent herniation at three years. All three had occasional or frequent back pain and one also had occasional aching in the dermatome in which the pain had radiated preoperatively. All the patients with extraforaminal herniations had satisfactory results. Muscle weakness had recovered in all patients, but there was mild dermatome hypoaesthesia in three.

All 22 patients employed outside their home before surgery had returned to their preoperative work. The mean time off work was 2.2 months (3 weeks to 5 months). The other patients had all returned to their normal lifestyle.

**Imaging studies.** Facetectomy for intraforaminal herniation was grade I in 11 and grade II in 20 patients (Figs 2 and 3). Three patients had grade III-excision, one total and two subtotal (Fig. 4). For extraforaminal herniation, facetectomy was grade I in three patients, grade II in five (Fig. 5), and subtotal in one. Patients with grade-I or grade-II facetectomy showed no significant correlation between the amount of articular processes excised and the clinical result.

Of the four patients who had grade-III facetectomy, three, including the patient with total facetectomy, had fair results at the three-month follow-up because of back pain.

**Table IV.** Clinical results at three months related to the operative diagnosis of the type of intraforaminal herniation

<table>
<thead>
<tr>
<th>Result</th>
<th>Contained</th>
<th>Extruded</th>
<th>Sequestrated</th>
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<tr>
<td>Excellent</td>
<td>3</td>
<td>5</td>
<td>14</td>
</tr>
<tr>
<td>Good</td>
<td>3</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Fair</td>
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<tr>
<td>Poor</td>
<td>2</td>
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<td></td>
</tr>
<tr>
<td>Total</td>
<td>9</td>
<td>10</td>
<td>16</td>
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**Fig. 2a**

Grade-I facetectomy. Figure 2a – Preoperative CT showing an L4-L5 contained intraforaminal herniation on the right. Figure 2b – Postoperative radiograph showing that resection of the proximal lamina and inferior articular process is less than 50% of the width of the opposite lamina and articular process.

**Fig. 3a**

Grade-II facetectomy. Figure 3a – Preoperative CT showing a sequestrated intraforaminal herniation at the L4-L5 level on the left. Figure 3b – Postoperative radiograph showing resection of more than half of the L4 lamina and inferior articular process in the transverse plane.
but all four had good results at the latest follow-up. None of the patients without degenerative spondylolisthesis showed hypermobility on flexion-extension radiographs after operation, and the two with preoperative slipping, showed no increase, including one who had mild hypermobility preoperatively and a grade-II facetectomy. The five postoperative MRIs all showed complete disappearance of the herniation (Fig. 5).

Discussion

Most reports on lateral herniation of discs make no clear-cut distinction between intraforaminal and extraforaminal lesions, which may account for the high prevalence of extrafominal herniations in some studies. Based on our definitions, extrafominal herniation appears to be fairly rare, 20% in our series.

Extrafominal herniations are often associated with posterior annular bulging or posterolateral protrusion, found in eight and six of our patients, respectively. Lateral herniation is reported to occur at an older mean age than that in other parts of the disc, and may be associated with spinal stenosis. Four of our patients had concomitant spinal stenosis and two of them showed degenerative spondylolisthesis of the vertebra above the herniated disc.

CT and MRI may not determine whether a lateral herniation is contained, extruded or sequestrated. For intrafominal herniations, this may be a serious drawback at operation by any approach, since much time is needed to determine the presence of an extruded or free fragment in the intervertebral foramen. We found that preoperative imaging was accurate in 83% of intrafominal herniations,
with most uncertainty before surgery between contained and extruded herniations. When there is doubt after both CT and MRI, it is essential to explore the inferolateral portion of the vertebral body above the involved disc, especially when little tissue has been excised from the lateral part of the disc.

The naked-eye excision of an intraforaminal herniation through an interlaminar approach is very demanding, mainly because of poor lighting of the deep surgical field. Subtotal or total facetectomy is often performed inadvertently, particularly when the preoperative diagnosis of the type of herniation is uncertain. These drawbacks have led to increased use of extravertebral approaches commonly with the aid of an operating microscope. The paraspinous or paraspinal approaches have given satisfactory results, for the four largest reported series of from 70% to 80% in three and up to 92% in the other.1,4,13,18 Two series report postoperative dysesthesia in 16%24 and 24%1, probably due to surgical manipulation of the dorsal root ganglion. Other drawbacks of these approaches are that they are technically demanding or impossible at the L5-S1 level18 and that it may be difficult to remove a concomitant posterolateral or paramedian disc protrusion, and that it is difficult or impossible to decompress the neural structures in the presence of lateral or central stenosis. When there is stenosis, a combined extravertebral and intracanal approach has been reported,2,4,11 but this so-called mixed exposure20 increases the operating time, risks complete facetectomy with postoperative instability,2 and fails to increase the proportion of satisfactory results beyond that for the extraforaminal approach.2,9

The use of an operating microscope allows the easy visualisation and removal of an extruded or sequestrated intraradicular herniation through a limited facetectomy. Of our patients with intraradicular herniation, only 8% had subtotal removal of the facets and only one had an inadvertent complete facetectomy. Our results were excellent or good in 88% in the short term and in 91% at two years, with the best results for sequestrations and the worst for contained herniations. One possible explanation for this difference is that some patients thought to have a contained herniation at operation also had an extruded or sequestrated fragment which was not detected. This interpretation is conceivable for the single patient who had only slight improvement of leg pain after surgery. The other unsatisfactory results may be related to the mild compression of a nerve root by a contained herniation: as reported for patients with a posterolateral herniation, the result of surgery tends to be less satisfactory when nerve-root compression is mild than in the presence of severe compression.25

It has been considered that an extraforaminal herniation cannot be removed through an interlaminar approach, but we were able to do this after the removal of only a limited part of the facet joint. This was also possible for sequestrated herniation when 40% of the free fragment of the disc was within the intervertebral foramen, but this may not be possible when it is entirely outside the foramen. This is extremely rare, and is unlikely to produce radicular symptoms, because of the more medial location of the nerve root with respect to the disc fragment. One advantage of an interlaminar approach is the avoidance of manipulation of the nerve root during the exposure and excision of the herniated disc, and this may explain the rapid recovery and high proportion of excellent or good results even at short-term follow-up. The risk of damaging a nerve root lying close to the lateral portion of the disc during removal of a herniation is avoided if the pituitary rongeur remains within the intervertebral space. An operating microscope allows clear vision of the lateral annulus when an angled pituitary rongeur is inserted into the disc, or the lateral annulus is ruptured with a 90° angled probe.

The interlaminar approach allows the easy excision of a paramedian or posterolateral protrusion presenting with a lateral herniation, and decompression can readily be performed for spinal stenosis.

We found no significant correlation between the amount of the facet joint removed and the clinical result after grade-I or grade-II facetectomy, but most of our patients after grade-III facetectomy had more severe early back pain than the others, although this settled in the longer term. The reason may be that such motion segments become temporarily unstable after facetectomy associated with disc excision, but that later healing in the disc restores stability to a large extent. By contrast, in a motion segment which is unstable preoperatively, subtotal or total facetectomy will cause chronic instability and disabling back pain. This interpretation is supported by reports that when total facetectomy is performed routinely,3,19 spinal fusion is occasionally required for persistent back pain. We believe that spinal fusion is not indicated after total facetectomy during excision of a lateral herniation of the disc unless the motion segment is known preoperatively to be unstable.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References


