PAPER

Lateral transmuscular or combined interlaminar/ paraisthmic approach to lateral lumbar disc herniation? A comparative clinical series of 48 patients

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Background: The optimum operative technique for lateral lumbar disc herniations (LLDH) remains unclear, and both interlaminar and extraspinal approaches are used.
Objective: To compare outcome after LLDH removal either by a lateral transmuscular approach (LTM) or by a combined interlaminar and paraisthmic approach (CIP).
Methods: 28 patients underwent surgery using CIP and 20 using LTM. All patients were operated on by the same neurosurgeon. The clinical presentation of the two groups was comparable. Overall outcome was assessed after a mean follow up period of between 19 and 37 months using the Ebeling classification. In addition, the effect of surgery on radicular pain, low back pain, and sensory and motor deficits was defined.
Results: Excellent to good results were achieved in 95% of the LTM group and 57% of the CIP group. The outcome was satisfactory to poor in 5% of the LTM and 43% of the CIP group ($p<0.004$). The percentage of sensorimotor deficit and of radicular pain improvement was higher in the LTM group. New low back pain was found exclusively in the CIP group (21%). The complication rate was 5% in the LTM group and 11% in the CIP group.
Conclusions: The LTM approach achieves a better overall outcome and improvement in radiculopathy. The complication rate is lower with the transmuscular route and the risk of new low back pain is minimised. These results are likely to be attributable at least in part to the lesser invasiveness of the LTM approach.

Microsurgery of mediolateral lumbar disc herniations is probably the most frequent neurosurgical procedure currently undertaken. Lateral lumbar disc herniations (LLDH) are much less common and constitute only 3–10% of all lumbar disc operations.[1–5] LLDH were first described by Abdullah and co-workers in 1974 and the clinical features have often been discussed since then.[6–14]

During the last decade several surgical approaches to this type of herniation have been described. Some advocate the interlaminar medial approach with partial or complete facetectomy.[1 11 15–17] A drawback of this approach is the potential risk of destabilising the lumbar spine. Others prefer the lateral transmuscular approach (LTM),[2 3 18–20] which requires a certain expertise because the anatomy is less familiar to many neurosurgeons. To avoid facetectomy, while at the same time dealing with more familiar surgical anatomy, a combination of the interlaminar approach and partial removal of the lateral isthmus (combined interlaminar and paraisthmic approach (CIP)) was proposed.[21 22] Modifications of the CIP approach have been described, such as a combined approach with a small partial hemilaminectomy of the superior lamina and removal of the lateral portion of the superior facet joint of the inferior vertebral body,[23] or a far lateral hemilaminectomy and removal of the most superolateral aspect of the facet joint.[24] A translaminar fenestration craniomedially to the facet joint for foraminal herniation[25] and a pars interarticularis fenestration for foraminal and extraforaminal lumbar herniation[26] have also been proposed. Percutaneous endoscopic procedures for the surgery of lumbar disc prolapses have been introduced in the past few years.[27–29] In 2001 Lew and colleagues described the percutaneous endoscopic treatment of LLDH through a transforaminal approach.[28]

The best surgical approach remains open to discussion, partly because studies reporting the results of a single surgical technique are abundant, but studies comparing different approaches are lacking. It was our objective in the present study to compare the clinical results in 48 patients with lateral lumbar disc herniations who had been operated on by a single neurosurgeon either by the LTM or by the CIP route.

METHODS

Patients

The operative records of a single neurosurgeon (VR), hospital case notes, outpatient department and rehabilitation documents, and radiographic images were reviewed for all patients who underwent microsurgery for primary and recurrent lateral lumbar disc herniations. Patients with far lateral osseous stenosis were excluded. Patients who were treated by other surgeons in the same time period were excluded to minimise the bias from interindividual differences in operative techniques and skills.

In all, 48 patients with primary LLDH could be identified. Twenty of these (16 men and four women, mean age 49 years) were operated on by the LTM technique; the remaining 28 (13 men and 15 women, mean age 56 years) underwent surgery by the CIP technique. From 1991 to 1994, the preferred operative technique was the CIP route; from 1995 to 2000 the preferred technique was the LTM route.

Before surgery, all patients with radiculopathy and sensory deficits but without paresis underwent a course of conservative treatment with non-steroidal anti-inflammatory drugs, bed rest, and physiotherapy.

Abbreviations: CIP, combined interlaminar and paraisthmic (approach); LLDH, lateral lumbar disc herniation; LTM, lateral transmuscular (approach)

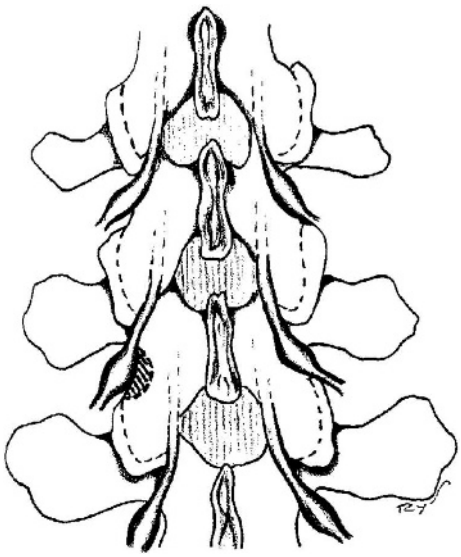

Figure 1 Amount of bony resection of the lateral isthmus (hatched crescent shaped area) needed for the lateral transmuscular approach (LTM).

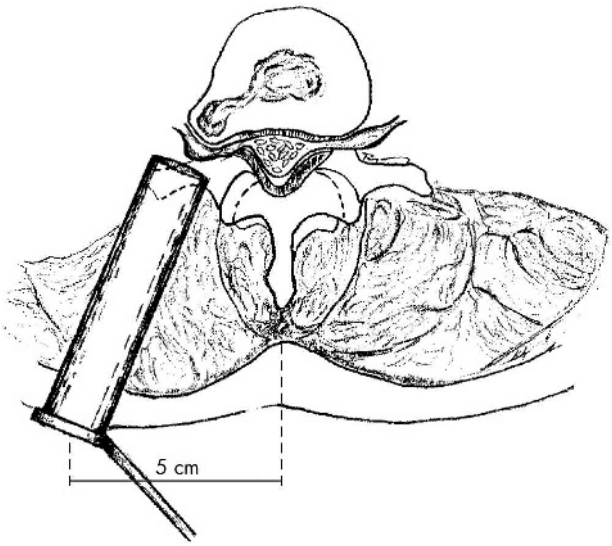

Figure 2 Transverse aspect of the lateral transmuscular approach (LTM) with lateral disc herniation and inserted retractor.

Surgical techniques

To localise the surgical segment, lateral fluoroscopy is carried out after positioning the patient. With a spinal needle inserted into the paraspinal muscles of the opposite side, the level of the transverse process of the superior body is marked. After insertion of the retractor, lateral fluoroscopy is repeated for reconfirmation of the correct level.

Far lateral transmuscular approach

A 4 cm horizontal skin incision is made approximately 5 cm lateral to the midline at the caudal limit of the transverse process of the superior body. The lumbodorsal aponeurosis is incised and the multifidus and longissimus muscles bluntly separated as atraumatically as possible with a dissector. After identifying the superior transverse process, the lateral facet joint, and the lateral isthmus (pars interarticularis), a self retaining Caspar retractor is inserted in a slightly oblique fashion and the microscope is brought into place. Parts of the adherent medial intertransverse muscle are removed. In only a few cases is an additional reduction of the lateral isthmus with a high speed drill necessary to visualise the lateral aspect of the ligamentum flavum. Even though this was rarely needed in our cases, the part of the isthmus that needs to be reduced to expose the lateral aspect of the yellow ligament is nevertheless highlighted in the illustration for better visual comprehension. After resection of lateral parts of the ligament the nerve root is exposed; it is usually dislocated cranially and dorsally by the disc herniation. The herniated disc material is exposed and removed. If necessary, the disc space is entered and emptied partially from the lateral aspect (figs 1 and 2).

Combined interlaminar and lateral paraisthmic approach

The first steps of the operation are the standard interlaminar approach to the intervertebral disc space, with partial hemilaminectomy and flavectomy. Hemilaminectomy and flavectomy have already been done microscopically. The lower nerve root is disclosed, and the intraforaminal part of the herniated disc and the nucleus pulposus tissue of the intervertebral disc space are removed. In the second part of the operation the paravertebral musculature is retracted further laterally to visualise the lateral border of the isthmus and the upper facet joint. In contrast to the LTM approach, lateral drilling of the isthmus (and occasionally of the uppermost part of the facet joint) is almost inevitably necessary to expose the lateral aspect of the ligamentum flavum, which is then removed. Directly beneath the ligament, the disc herniation, and lateral to it the upper nerve root, can be identified. Disc herniation and any intraforaminal disc fragments that have been overlooked are removed (figs 3 and 4).

Outcome assessment

The complications and the short and long term outcome were assessed by reviewing the patients' hospital records for the immediate postoperative course, the results of the first follow up examination at six to eight weeks postoperatively, and the records from rehabilitation institutions. Direct standardised telephone interviews were used at six to 78 months after

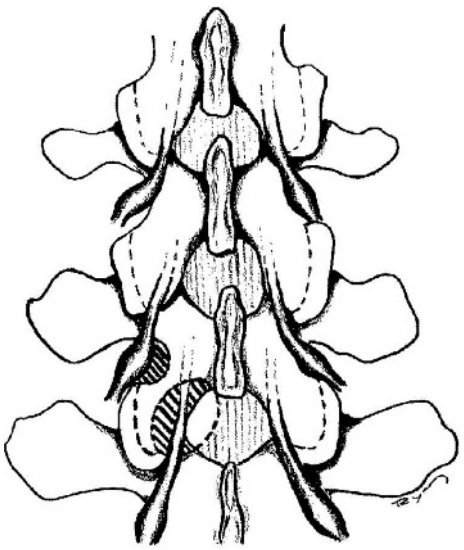

Figure 3 Amount of bony resection of the lateral isthmus plus the partial hemilaminectomy/flavectomy and medial facetectomy (hatched crescent shaped areas) needed for the combined interlaminar/paraisthmic approach (CIP).

surgery to assess the long term outcome (table 1). The Ebeling scale,[30] an accepted European outcome scale after lumbar disc surgery,[21 31] was applied to categorise the outcome.

The telephone interviewers (YR, IR) were not blinded to the operative procedure but did not take part in the surgical and postsurgical management of the patients. Long term outcome assessment of the CIP group was made in 1995, and of the LTM group in 2001, which explains the different mean follow up periods (CIP group 19 months; LTM group 36.5 months).

Statistical analysis

To compare the CIP with the LTM group for preoperative clinical presentation and long term outcome, we used the Mann–Whitney U test. The significance level was set to $p<0.05$.

RESULTS

Preoperative clinical presentation and neuroimaging

The features of the two patient groups relating to clinical symptoms, levels of involvement, location of the disc prolapse, previous surgery, and significant statistical differences are given in table 2.

Computed tomography was carried out in all patients, with additional magnetic resonance imaging in nine of the LTM and seven of the CIP group. Radicular pain or neurological deficits were the main indications for surgery. Patients with low back pain alone were advised to have another trial of conservative treatment.

There was no significant difference between the two patient populations for clinical and demographic data (age, sex, preoperative and postoperative clinical symptoms, neurological deficits, or location of the prolapsed discs), proving that the two groups were homogeneous and therefore comparable. Exceptions were a higher percentage of preoperative low back pain in the LTM group ($p<0.01$) and a higher incidence of new postoperative low back pain in the CIP group ($p<0.01$).

Surgical outcome

LTM group

Long term outcome (mean follow up period of 36.5 months) was excellent in four (20%), good in 15 (75%), and satisfactory in one (5%) of the 20 patients (table 3).

Significant improvement after surgery in low back pain, radicular pain, and motor and sensory deficits was achieved in all patients in the LTM group except one whose sensory deficit was unchanged. The preoperative neurological state was not worsened in any of the 20 patients (table 4).

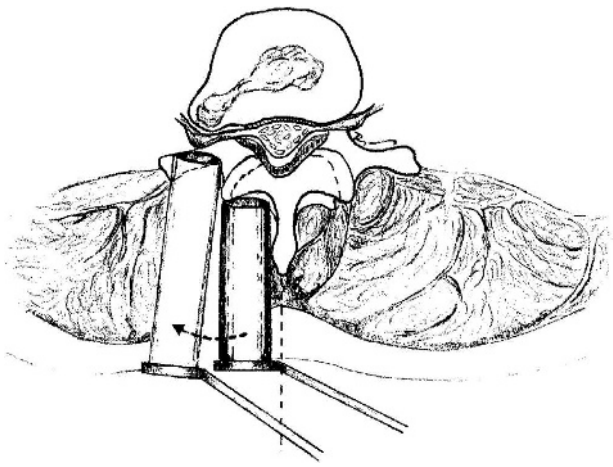

Figure 4 Transverse aspect of the combined interlaminar/paraisthmic approach (CIP) with lateral disc herniation and inserted retractor (step 1: interlaminar medial position of retractor; step 2: paraisthmic lateral position of same retractor).

Table 1 Ebeling outcome criteria for overall assessment of the results of lumbar disc surgery

Classification	Criteria
Excellent	Free of neurological symptoms with no/occasional mild low back pain or radicular pain; normal working capability
Good	Mild residual motor or sensory deficit and/or mild low back pain or radicular pain; normal working capability
Satisfactory	Significant improvement of motor or sensory deficits and pain; reduced working capability
Poor	No or insufficient improvement of pain and/or motor or sensory deficits; reduced working capability/incapable of work

Table 2 Presenting symptoms grouped according to the selected approach (lateral transmuscular approach (LTM) versus combined interlaminar/paraisthmic approach (CIP))

Clinical features	LTM	CIP	p Value
Symptoms			
Low back pain	14 (70%)	6 (21%)	p<0.01
Radicular pain	19 (95%)	28 (100%)	NS
Sensory deficit	16 (80%)	19 (68%)	NS
Motor deficit	12 (60%)	15 (54%)	NS
Level			
L3/4	9 (45%)	4 (14%)	
L4/5	6 (30%)	16 (61%)	
L5/S1	5 (25%)	7 (25%)	
Location			
Extraforaminal	12 (60%)	13 (46%)	
Intra-/extraforaminal	8 (40%)	4 (14%)	
Intraforaminal	0	11 (39%)	
Previous surgery			
Same location	2 (10%)	1 (4%)	
Different level	6 (30%)	4 (14%)	

CIP group

Long term outcome (mean follow up period 18.8 months) was excellent in five (18%), good in 11 (39%), and satisfactory in nine of the 28 patients (32%). In three patients (11%) the outcome was poor (table 3).

Marked improvement in preoperative symptoms could also be achieved in the majority of patients in the CIP group. Though neurological deficits were not worsened in any patient, there was a significant number in whom radicular pain or motor/sensory deficits did not improve after surgery. In six patients (21%) new postoperative low back pain occurred (table 4).

LTM group versus CIP group

Symptom improvement was more pronounced in the LTM group. Motor deficit improvement was achieved in 100% *v* 80%; sensory deficit improvement in 94% *v* 74%; and radicular pain improvement in 100% *v* 86%. Low back pain improvement was 100% in both groups, but new low back pain occurred in 21% of the CIP group ($p<0.01$). There was no statistically significant difference between the groups concerning improvement in postoperative motor/sensory deficits and radicular pain. A substantial benefit from surgery (excellent to satisfactory results) was reported by all patients

Table 3 Overall postoperative results with respect to the approach used (lateral transmuscular (LTM) and combined interlaminar/paraisthmic (CIP))

Outcome	LTM	CIP
Excellent	4 (20%)	5 (18%)
Good	15 (75%)	11 (39%)
Satisfactory	1 (5%)	9 (32%)
Poor	0	3 (11%)

Excellent to good (LTM (95%) > CIP (57%)), p<0.004
Satisfactory to poor (CIP (43%) > LTM (5%)), p<0.004

in the LTM group and by 89% of the patients in the CIP group. Excellent to good outcome was more likely in the LTM group (p<0.004), while satisfactory to poor outcome was more likely in the CIP group (p<0.004), showing that the overall outcome was significantly better for the LTM group.

Complications

LTM group

One patient presented with a recurrent disc herniation 16 months post-surgery. The patient was treated conservatively and made a satisfactory recovery. The complication rate in the LTM group was 5%.

CIP group

Three patients presented with symptomatic scar tissue formation. One patient underwent two further operations and had a poor outcome because of unchanged radicular pain and lack of improvement in sensory and motor deficits. Each of the other two patients underwent one further operation; one had a satisfactory and the other a poor outcome, with unchanged radicular pain. Two patients had fractures of the thinned pars interarticularis on postoperative *x* ray. However, this complication did not interfere with good recovery in one patient, who only complained of minor low back pain postoperatively; the other patient had a poor outcome despite improved motor deficits, because of unchanged radicular pain and sensory deficits. Low back pain after surgery was mild in this latter patient. In one patient a dural tear with intraoperative cerebrospinal fluid flow occurred. The dural tear was sutured directly without any further sequelae and the patient had an excellent recovery. The complication rate in the CIP group was 21%.

DISCUSSION

Various different surgical approaches to LLDH, with their advantages and disadvantages, have been described since 1974. Many neurosurgeons still use the anatomically familiar posterior midline interlaminar approach with hemilaminectomy and partial to complete facetectomy.[5 15 17 24 32 33] However, good to excellent results after facetectomy are achieved in only 70%.[24] A minor disadvantage of this approach is the need for substantial nerve root manipulation if the disc prolapse is lateral to the upper nerve root. A major disadvantage, and possibly the explanation for the less favourable results, is the destabilisation of the spinal segment owing to removal of the facet joint. In the Epstein's series, six of 170 patients (4%) required reoperation for spinal fusion.[24] Because of the impending instability, Kunogi and Hasue routinely carried out spinal fusion after facetectomy for LLDH.[33]

The combined interlaminar and paraisthmic (CIP) approach

The CIP approach allows control of the complete neuroforamen and visualisation of both the upper and the lower nerve roots without destroying the facet joint.[21 24] Furthermore, it provides exposure of the extraspinal and intraspinal intervertebral disc space with the possibility of achieving a more thorough nucleotomy. By doing the paraisthmic part of surgery after the standard interlaminar approach, the operative field remains familiar to the surgeon. From 1991 to 1994, VR exclusively used the CIP approach because of his preference for dealing with familiar anatomy. In our series, the long term outcome in the CIP group was excellent to satisfactory in 89%, which is in line with other published series,[21 24] and better than for the more invasive and destabilising facetectomy. More patients suffered from low back pain after surgery, which could reflect an excessive degree of bony resection. The gross integrity of the joint is preserved with the CIP approach, but nonetheless the joint may be irritated, with resulting low back pain. Late fractures of the pars interarticularis, as seen in two of our patients, support the view that the CIP approach remains a fairly invasive procedure. Another cause for increased low back pain may be the dorsomedian approach with extensive subperiostal muscle retraction. This may endanger the posterior rami of the spinal nerves of the deep paraspinous muscles and cause denervation, resulting in increased low back pain immediately after surgery because of direct trauma to the paraspinous muscles, and long term low back pain from sequelae of denervation (muscle atrophy, muscle dysfunction, and segmental dynamic instability).[34–36]

The lateral transmuscular (LTM) approach

This minimal access procedure, which has been extensively described,[37 38] is significantly better than facetectomy and gives better results than ours and other surgeons' using the CIP approach. Osseous removal is reduced to a minimum: Only the lateroinferior part of the isthmus has to be drilled away, if any. The oblique approach enables the surgeon to view nearly the entire neuroforamen. The facet joint usually remains untouched in most patients. Thus the risk of postoperative instability and a chronically irritated joint is

Table 4 Effect of surgery on symptoms (lateral transmuscular approach (LTM) versus combined interlaminar/paraisthmic approach (CIP))

Symptoms		Total preop	Resolved	Improved	Unchanged	New
Low back pain	LTM	14	6 (43%)	8 (57%)	0	0
	CIP	6	3 (50%)	3 (50%)	0	6 (21%)
Radicular pain	LTM	19	14 (74%)	5 (26%)	0	0
	CIP	28	15 (54%)	9 (32%)	4 (14%)	0
Motor deficit	LTM	12	5 (42%)	7 (58%)	0	0
	CIP	15	3 (20%)	9 (60%)	3 (20%)	0
Sensory deficit	LTM	16	4 (25%)	11 (69%)	1 (6%)	0
	CIP	19	5 (26%)	9 (47%)	5 (26%)	0

Preop, preoperative.

reduced. The rather gentle muscle splitting procedure avoids the risk of denervation of the dorsal ramus, explaining the relief from low back pain in all the patients. No new low back pain or late fracture of the pars interarticularis occurred. Disadvantages of the LTM approach are the unfamiliar extraspinal anatomy, the steep learning curve especially in the presence of anatomical variations, and the difficulty in removing truly intraspinal fragments of the disc safely. In the case of an LLDH at level L5/S1, the oblique view of the herniation may be hampered by a high iliac crest or by a thick degenerative facet joint. Osseous reduction is therefore more likely to be necessary than in higher segments. If visualisation is limited, the superomedial part of the iliac crest can be reduced. The most superolateral part of a hypertrophic joint is only resected subsequently if the operative approach is still too limited for identification of the nerve root and the disc herniation. Currently, the LTM approach is the preferred one for lateral lumbar disc herniations at our institution.

Approach selection

Ample operative experience and good imaging techniques—showing the site of disc herniation with sufficient detail—allow the surgeon to select the approach which best fits the individual patient. However, only a few surgeons have acquired sufficient expertise to do this, because of the relative rarity of LLDH.[16] It is more common for a single approach to be used for all LLDH cases. Thus a comparison of the CIP with the LTM approach, which are both frequently used, seemed justified.

Limitation of the study

We did not carry out a prospective randomised study. Rather, we compared two consecutive retrospective series conducted independently. The first series examined the CIP approach, which was the commonly used approach in the early period covered by the study. A second series investigated the LTM approach, which gradually replaced the CIP approach. The study of two independent consecutive series is the explanation for the different follow up periods. In the first series, follow up was planned for 18 months, and in the second series for 36 months. As the clinical outcome tends to deteriorate over time, the more favourable results in the LTM group despite a longer follow up is further evidence in favour of the LTM approach. The mainly consecutive use of the CIP approach in the beginning and the LTM approach later on resulted in two learning periods for the surgeon. However, the increasing general surgical experience over time may to have influenced the postoperative results in favour of the LTM approach, as this was the one used in the later period of the study. Nevertheless, even though our study was a retrospective, non-randomised trial, we believe that it allowed a good comparison of these two approaches to lateral lumbar disc herniation.

In our series we excluded patients with a purely osseus stenosis. We are aware that there is a high coincidence of lateral disc herniation with concomitant stenosis. We have treated patients with accompanying stenosis with both of the approaches described here, as proposed by Ahn *et al*,[39] who use a lateral endoscopic procedure, whereas Hejazi *et al* use a combined approach.[40] Our main focus in this study was nevertheless targeted towards the surgical outcome of patients with pure lateral disc prolapses.

Conclusions

The operative results of the LTM approach are better than those of the CIP approach. We believe that the better results are related to the lesser degree of invasiveness of the LTM approach. A minimal amount of bone removal at the lateral pars interarticularis allows complete visualisation of the extraforaminal/intraforaminal area and leaves the facet joint untouched, which we assumed to be beneficial for avoidance of instability and low back pain. At our institution, the LTM approach is the procedure of choice for patients with lateral lumbar disc herniations. It is possible that endoscopic LTM surgery will replace microsurgical LTM in the future as an even less invasive procedure.

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