The surgical treatment of far lateral lumbar disc herniation : 33 cases

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Surgical approaches to far lateral disc herniation are challenging because of the anatomical limitations in the region. We describe an extraforaminal approach for far lateral lumbar disc herniation (FLLDH) in a group of patients and discuss the results in patients with far lateral disc protrusion or extrusion operated on by an approach to the extraforaminal region via an intertransverse route with median or paramedian incisions. The two methods are compared in terms of the pre- and postoperative visual analogue scale (VAS) pain scores, duration of the operation, amount of bleeding, and long-term functional recovery. In addition, data on age, incidence, radiological features and clinical signs and symptoms are compared with reported series.

Between January 2006 and January 2011, 33 patients (18 females, 15 males ; mean age, 51.2 years) underwent surgery for FLLDH. The majority of patients had herniation at disc levels L3-4 (12 patients) or L4-5 (15 patients). All patients were operated on via either median-paramuscular (20 patients, 61%) or paramedian-intermuscular (13 patients, 39%) approaches. Overall, the mean VAS score improved from 7.3 preoperatively to 2.8 in the short-term. Analyzing the long-term functional outcome of surgery according to the MacNab Criteria, the recovery was excellent, good, fair, and poor in 18, 11, 4, and 0 patients, respectively.

The far-lateral approach for FLLDH is a safe, effective procedure that avoids the risk of secondary spinal instability. In treating FLLDH, the use of a long median incision together with an extraforaminal approach is safer and less invasive than a laminectomy together with a medial or total facetectomy.

INTRODUCTION

Far lateral (= extreme lateral = extracanalicular) lumbar disc herniation (FLLDH) is a clinical entity involving compression of the nerve root outside the vertebral canal, in its extraforaminal/extracanalicular course at the inferior or lateral part of the facet joint (*2*). FLLDH comprises 7-12% of all lumbar disc herniation (*2,15,36,38*). Typically, FLLDH compresses the nerve root at the same level, rather than at the level below (*44*). The symptoms of FLLDH include minimal lumbar pain and notable lower limb pain in the area innervated by the compressed

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root. The pain is usually accompanied by a sensory or motor deficit (25). Radiological examinations such as computed tomography (CT) or magnetic resonance imaging (MRI) are necessary to diagnose FLLDH. This type of herniation can be treated via a variety of posterior surgical approaches, including a medial facetectomy intertransverse technique, full facetectomy transpars technique, extraforaminal technique (11), and minimally invasive techniques, such as percutaneous endoscopic techniques. This report presents the clinical, radiographic, and operative results of our FLLDH patients.

MATERIALS AND METHODS

The clinical data for 33 (18 females, 15 males) consecutive patients who underwent surgery for FLLDH between 2006 January and 2011 January were reviewed retrospectively from medical reports and outpatient charts. The mean age of the study group was 51.2 (range 25-71) years. The records of all patients were analyzed in terms of the clinical signs and symptoms, operative findings, surgical complications, and outcome. The records regarding the presence of back pain or sciatica were analyzed based on a visual analog scale (VAS). Each patient underwent preoperative lumbar MRI and dynamic roentgenograms were studied. The level involved was L2-3, L3-4, L4-5, and L5-S1 in 4, 12, 15, and 2 patients, respectively. Either a median-paramuscular or paramedian-intermuscular approach was used. The short-term VAS results of surgery were determined 6-8 weeks postoperatively and the long-term functional evaluation was categorized as excellent (no pain), good (some pain), fair (moderate pain), or poor (unchanged or worse) based on the MacNab classification (26) (Table I).

All patients included in the study had : a) single-level, unilateral foraminal or extraforaminal disc herniation demonstrated on MRI ; b) spontaneous radicular pain (sciatica or femoralgia) or pain provoked by straight-leg raising, consistent with the radiological findings ; c) complaints unresponsive to conservative treatment, including strict bed rest and non-steroidal anti-inflammatory medication, involving a recurrent or progressive neurological deficit ; and d) no history of lumbar disc surgery.

Surgical method

The surgical management of far lateral disc herniation is more difficult and complicated than that of paramedian or foraminal disc herniation (32). Many surgical approa-

Table I. — The MacNab Classification

Grade	Description
Excellent	No pain; no restriction of activity.
Good	Occasional back or leg pain of sufficient severity to interfere with the patient's ability to do his normal work or his capacity to enjoy himself in his leisure hours.
Fair	Improved functional capacity, but handicapped by intermittent pain of sufficient severity to curtail or modify work or leisure activities.
Poor	No improvement or insufficient improvement to enable increase in activities; further operative intervention required.

ches for far lateral disc herniation have been described, including a 1) median approach performing both medial and total facetectomies, 2) combined intertransverse approach, 3) anterolateral retroperitoneal approach, 4) percutaneous approach, and 5) paramedian extraforaminal approach (38,44,48). In addition, Foley et al. reported a novel surgical approach known as microendoscopic discectomy, which combines endoscopic and standard open surgical microsurgical techniques in the management of far lateral disc herniation (15,35). Procedures that involve both medial and total facetectomies can result in excessive bone removal, causing instability requiring fusion (32,39). Recently, a combined intertransverse/paramedian extraforaminal approach has gained popularity because it allows direct access to the far lateral space, without the excision of osteoligamentous structures (38,39,46).

The patients were operated on under general anesthesia in the prone position. Two separate surgical techniques were used : a median-paramuscular method (M) via a median skin incision or a paramedian-intermuscular (PM) approach via a paramedian incision. The approach was chosen based on the surgeon's experience. In both cases operated on at the L5-S1 level, the median approach was selected. For the median-paramuscular approach, a 6-7-cm median skin incision was used to open the fascia at the midline. The paraspinal muscles were dissected subperiosteally from the spinous processes and laminae, as in an interlaminar exposure. Retractors were placed in the operative field, exposing the upper and lower transverse processes at the affected disc level. In patients undergoing a paramedian-intermuscular approach, a 2-3-cm transverse skin incision was made 3-4 cm lateral to the midline. Passing the thoracolumbar fascia, and between the paraspinal muscles (iliocostalis and quadratus lumborum), the intertransverse ligament was

reached by finger dissection. The surgical level was confirmed with C-arm fluoroscopy and an appropriately sized Cushing-Landolt transsphenoidal speculum was placed in the field. After confirming the correct disc level and setting up a surgical microscope, the subsequent stages were the same for both approaches. First, the intertransverse ligament was dissected from the upper margin of the lower transverse process, removing it from the apex of the facet joint and isthmus laterally. For safe dissection of the transverse process, this was started proximally. At this stage, the posterior primary ramus of the spinal nerve was clearly seen passing from the medial side of the intertransverse ligament in some cases. Removing the intertransverse ligament laterally and superiorly, the spinal nerve was found in the extraforaminal fat. Next, the nerve was secured and the intertransverse ligament was freed from the upper transverse process and excised. Due to anatomical variability, very limited resection of the apex of the superior articular process was performed with a Kerrison rongeur for better exposure in some cases. In cases operated on at the L5-S1 level, the alar superior edge of the sacrum was drilled widely. After retracting the nerve root superiorly and laterally, the sequestrated disc fragments were removed and the disc space evacuated completely. A Hemovac drain was left in place only in patients operated with the median approach. All of the patients were discharged on the second postoperative day.

Statistical analysis

For the data analysis, the Statistical Package for the Social Sciences (SPSS) 19.0 was used. The Kolmogorov-Smirnov test was used to evaluate whether the quantitative data were distributed normally : parametric methods were used for normally distributed variables and nonparametric methods otherwise. For pair-wise comparisons of independent groups, the independent t-test and Mann-Whitney U-test were used. Repeated measures analysis of variance (ANOVA) was used to compare groups with the Wilcoxon signed-rank test, Mann-Whitney U-test, or independent t-test as appropriate. To detect relationships between variables, Kendall's tau-b or Pearson's correlation was used.

Categorical data were compared using Pearson's chi-square or the chi-square test. Quantitative data were reported as the mean, standard deviation, median, and range. Categorical data were reported as numbers (n) and percentages (%). Data were reported with the 95% confidence levels and differences with a $p < 0.05$ were accepted as significant.

RESULTS

Between January 2006 and January 2011, 33 patients (mean age 51.2 (range 25-71) years ; 18 (55%) females, 15 (45%) males) were operated on for FLLDH. Our study group constituted 3.4% of all lumbar discectomy cases operated on at our hospital during the same period. The radicular pain was femoralgia in 21 cases, sciatica in three cases, and both in nine cases. The herniation level was at L2-3, L3-4, L4-5, and L5-S1 in 4, 12, 15, and 2 patients, respectively (Tables II and III).

All patients were operated on using either a median-paramuscular (20 patients, 61%) or paramedian-intermuscular (13 patients, 39%) approach. Overall, the mean operation duration was 63 ± 12 min, and was slightly longer (70 ± 10 min) with the median paramuscular approach. Both patients operated on at the L5-S1 level had considerably longer operation durations (87 min). Overall, the mean blood loss was 120 ± 20 mL, and it was significantly greater with the median approach (150 ± 20 mL). No blood transfusions were required at any time

Overall, the mean preoperative VAS score decreased from 7.3 to 2.8 in the short-term. There was no significant difference in the pre- and postoperative

Table II. — Presenting symptom according to disc level

Disc Level	Case no.	Femoralgia	Sciatalgia	Femoralgia + Sciatalgia
L2-L3	4	4	-	
L3-L4	12	11	-	1
L4-l5	15	6	1	8
L5-S1	2	–	2	–
Total	**33**	**21**	**3**	**9**

Table III. — Affected muscle groups according to disc level

Disc level	IP*	IP + QF**	QF	QF + TA***	TA
L2-L3	3	1			
L3-L4			5		
L4-l5			6	2	1
L5-S1					2

IP = iliopsoas, QF = quadriceps femoris, TA = tibialis anterior.

short-term pain control between the two surgical methods (Table IV).

There were significant ($p = 0.0000$) differences in the amount of bleeding and operation duration according to the preferred surgical technique (Table V). Examining the relationships among the amount of bleeding, operation duration, and VAS score, there was a strong relationship only between the operation duration and the amount of bleeding ($p = 0.806$, r = 0.000).

When the long-term functional outcome following surgery was analyzed according to the Mac-Nab Criteria, the recovery was excellent, good, fair, and poor in 18, 11, 4, and 0, respectively. The long-term functional recovery did not differ according to the surgical method used ($p = 0.227$).

DISCUSSION

Extraforaminal far lateral lumbar disc herniation (FLLDH) can be described as nerve root compression at the same disc level at the lateral side of the neural foramen involving superiorly migrating sequestrated fragments away from the extraforaminal area and extending to the foramen. It is challenging to diagnose these lateral protrusions. They cannot be demonstrated by myelography and are outside the surgical field. Lindblom first showed the presence of lumbar disc herniation outside the borders of the vertebral canal in a cadaver study in 1944 [24]. In 1971, MacNab reported his unsuccessful attempts to explore the L4-5 level of two patients with L5 radicular symptoms caused by the extraforaminal protrusion of the L5-S1 disc [26]. Abdullah et al. [1] first described the clinical entity FLLDH in 1974 and showed it on discography as 'extreme lateral' disc herniation under the facet at the same level or lateral to the intervertebral disc space.

The incidence of far-lateral disc herniation ranges from 7-12%, depending on the neuroimaging technique used [2,15,36,38]. The absolute rate of occurrence is highest at the L4-5 and L5-S1 levels, but the relative rate is higher at the upper lumbar L3-4 and L2-3 levels [10,29]. These findings are consistent

Table IV. — Pre- and postoperative short-term pain control according to surgical method

		M	PM	
Preop VAS	Mean	7,45	7,00	0,175 ns.
	Std.	0,94	0,71	
	Median	7	7	
	Maximum	9	8	
	Minimum	6	6	
Postop VAS	Mean	3,05	2,54	0,153 ns.
	Std.	0,83	1,05	
	Median	3	2	
	Maximum	4	4	
	Minimum	2	1	

M : Median approach, PM : Paramedian approach, std. : Standard Deviation – ns : nonsignificant.

Table V. — Amount of bleeding and operation duration according to preferred technique

		Groups		
		M	PM	
Amount of bleeding (cc)	mean	124	73,1	0,0000***
	Std.	28,9	25,0	
	median	125	70	
	maximum	180	140	
	minimum	80	40	
Operation Time (minutes)	mean	70,8	51,5	0,0000***
	Std.	9,9	5,5	
	median	70	50	
	maximum	90	60	
	minimum	50	45	

with the anatomy of the lumbar spine, because with caudal progression, the pedicles diverge and the orientation of their long axis changes (3,40,41). In the upper lumbar spine, the extraforaminal space is proportionally larger than at the lower lumbar levels, which explains the higher relative frequency of extreme-lateral disc herniation.

The series of Abdullah *et al.* (1) contained no cases at the L5-S1 level. In later series, the rate at the L5-S1 level was higher (27,31,37). In their series of 178 cases, Porchet *et al.* (37) reported a rate of 38% for the L5-S1 level, while O'Hara *et al.* (30) reported 25%. In our series, there were only two (6%) L5-S1 FLLDH. The reason might be our unwillingness to perform this challenging technique at this level because of a lack of experience in the early years of FLLDH surgery.

Another particularity of far-lateral disc herniation is its occurrence in older patients, with a peak incidence in the sixth decade (29,37), compared with classical paramedian disc herniation with a peak incidence in the fifth decade (5,33). In our series, the peak incidence was in the fifth decade of life.

Clinical signs and symptoms

Far lateral lumbar disc herniation compresses the nerve root emerging at the same level, which differs from typical posterolateral disc herniation, which compresses the nerve root at a lower level. The clinical picture results from compression of the nerve root ganglion, typically involving one nerve root,

and is characterized by severe pain and motor and sensory deficits (7,9,10). In FLLDH, the radicular pain is especially severe, probably due to direct contact of the annulus or sequestrated nucleus fragments with the dorsal root ganglion (34). In our series, the mean preoperative VAS score was high (7.3 ± 0.9). FLLDH frequently cause femoral neuropathy by compressing the upper nerve roots (1,14,37). The femoral stretching test is usually positive (12,37). In one series, this rate was 75% (30). In our series, the rate of L4 and higher nerve root compression was 90%. Provocative tests, such as femoral stretching, were positive in 63%. In these cases, the Lasègue test was less reliable for localizing radix compression, but it is not always normal (1,2,29) ; of our patients, 27% had positive Lasègue-assisted femoralgia. Except for the two cases with L5-S1 pathology, only one case (L4-L5) had sciatica alone (3%). Abdullah *et al.* (1) reported that 4% had a positive Lasègue test, although no cases had L5 radix compression.

In our series, 20 patients had motor deficits. The most frequent symptom was weakness of the quadriceps femoris (14 cases) and iliopsoas (4 cases) muscles.

Radiology

Disc herniation beyond the neural foramen usually cannot be demonstrated with myelography (27). In a series diagnosed with discography, the reported rate of FLLDH in all lumbar disc herniation was

0.7% (23). With the development of high-resolution computed tomography (CT) and MRI, neuroradiologists and neurosurgeons could see how a nerve root could be compressed at the herniation level at the outlet of the neural foramen, imitating the symptoms of upper level paramedian disc herniation clinically (29). In older series, many cases were diagnosed as FLLDH with high-resolution CT and treated (2,12,14,20,23,34,37). In our series, some patients underwent spinal CT, and all had MRI. Even advanced CT machines cannot reveal the relationship between a herniated disc and nerve root as effectively as can MRI (18). On sagittal MRI scans passing through the foramen level, the extraforaminal fat surrounding the nerve root provides information about the foramen opening. This makes the decision to perform conservative therapy easier in FLLDH patients who have signs and symptoms and easily recognizable perineural fat tissue, but no superior migration.

Treatment/Management

Conservative treatment

Conservative treatment is the first step in treating FLLDH. Unless there is a motor deficit requiring surgery, 2 weeks of conservative treatment should be tried (2,11,43).

Surgery

Many surgical techniques for treating FLLDH have been described, but there is no consensus on the best. The most commonly used method is a posterior median incision and hemilaminectomy combined with a total or mesial partial facetectomy (2,11,12,16, 22,34,42,45). The advantage of this method is familiarity with the anatomy. With median exposure, the affected nerve root can be seen clearly. Sometimes, the surgeon becomes disorientated during the surgery and must follow the lower nerve root to reach the far lateral disc space. In addition, a median approach to reach the far lateral disc space requires substantial bone removal, which can result in instability. In cases treated with a facetectomy with interlaminar approach instability (4,16,

17,38,42), severe low back pain (14) has been reported and fusion should be considered (22). Kunogi and Hasue (22) achieved poor clinical results performing a total facetectomy or pars interarticularis resection alone and reported that fusion is essential in cases of facetectomy. To reduce the amount of bone resection, many authors have proposed an extraforaminal approach (14,42).

Far lateral lumbar disc herniation is usually sequestrated, with some fragments migrating superiorly and laterally (80%) (1,8,11,14,19,42). Such sequestrated fragments causing persisting radicular pain can be missed (42). In such cases, the interlaminar opening should be widened upwards and laterally. This requires considerable bone resection from the base of the inferior articular process of the upper vertebra towards the pars interarticularis (41). Although the facetectomy is partial, the resected bone weakens the base of the bony articular process, causing fracture. Not all unilateral total facetectomies lead to spinal instability, as proponents of the median interlaminar approach suggest, but there are many examples (13,16,22,45).

In FLLDH, more appropriate and direct intervention methods are used after performing CT (21,31,47) and MRI (6,31) to localize the lesion exactly. Since the mid-1980s, the intertransverse route has been used to access the extraforaminal region and intervertebral foramen directly, with minimal bone resection. The median-paramuscular approach requires a wider incision and more soft tissue retraction, limiting foraminal exposure (14). Alternatively, with the paramedian-intermuscular approach, there is difficulty with orientation due to the lack of anatomical landmarks (19,45). In our series, no patient with the median-paramuscular approach required facet joint resection from a lateral approach. This might have been because our incision was sufficiently long, allowing an oblique exposure.

In our series, there was no significant difference between the M and PM approaches in terms of the short- and long-term pain control and outcome. The intermuscular (paramedian) approach seems superior in terms of the operation duration and amount of bleeding, while the paramuscular (median) approach allows more of the disc to be evacuated and facilitates Osteofit resection.

The paramedian approach requires angled insertion into the disc space for a safe discectomy. With this technique, the disc herniation can be seen following excision of the intertransverse ligament nerve root, without pars intervertebralis resection, and discectomy can be performed. During the surgical procedure, radiographic imaging of the transverse process is essential (15).

As surgeons are unfamiliar with the far lateral space, gaining experience takes time and a lack of experience is one of the reasons that the paramedian approach is not favored (28). If disc evacuation from the medial side of the facet joint is required, it is impossible to perform with a paramedian approach. It is also difficult to perform a paramedian extraforaminal approach at the L5-S1 level, because the iliac crest limits the lateral approach. In both of our approaches, the dissection was started from the region described as Kambin's safe triangle.

None of the cases in our series was complicated. At follow-up, no instability as a result of surgery was encountered and no re-operations for recurrence were required.

Results of surgical treatment

In the literature, the best results reported for far lateral disc herniation range from 70-100%. In our series, at the long-term follow-up 55% had excellent results and 33% good results (total 88%). Kunogi and Hasue (22) reported a series including eight patients with intra- or extraforaminal disc herniation. One of the largest series in the literature with long-term follow-up is Porchet *et al.* (38). In their series of 202 cases, the mean follow-up was 50 months and 187 cases were operated on via a paramedian-transmuscular route and 15 cases via a median-paramuscular route. Overall, 87% had excellent or good results, while the surgical complication rate was 2%.

In two large series, Davis *et al.* (5) reported a surgery-related complication rate of 3.6%, whereas Pappas *et al.* (33) reported a complication rate of 9.9%. In another series (38), the reported rate was 1.5%. The high overall complication rate might be related to an older patient group. In their large series, Porchet *et al.* (38) reported 2% disc herniation

recurrence through the extreme lateral space and five of their cases (2.5%) had recurrent paramedian herniation on the same side and level. In our series, the overall recurrence rate was 4.5%, which is lower than in the two other reported large series, including classical medial-mediolateral lumbar disc herniation (5,33).

The difficulty accessing the intervertebral disc space with some approaches might explain disc recurrences from the paramedian area (38). It is possible that the intervertebral disc can be evacuated subtotally. Using the PM and M approaches in our patients, the amount of disc material evacuated from the intervertebral disc space equaled that with the classical interlaminar approach.

CONCLUSION

Treating intra- or extraforaminal disc herniation with a far lateral approach using either a median (paramuscular) or paramedian (intermuscular) technique is a safe, minimally invasive procedure. Some spinal surgeons are not familiar with this approach. As the paramedian approach is far from the usual bony landmarks, it can lead to orientation problems in inexperienced hands. Under these circumstances, the paramuscular (median) approach should be used until the surgeon becomes familiar with the regional anatomy. In FLLDH, the use of a long median incision together with the extraforaminal approach is safer and less invasive than a laminectomy together with a medial or total facetectomy. There was no difference in the short- and long-term pain control and outcome with the two methods used in our series. The intermuscular (paramedian) was superior in terms of the operation duration and amount of bleeding, while the paramuscular (median) approach enabled greater disc evacuation and facilitated Osteofit resection.

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