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Original Article

Percutaneous endoscopic lumbar discectomy for extreme lateral lumbar disc herniation

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ABSTRACT

Background: Far lateral disc herniation (FLDH) constitutes a minor portion of the total discectomy workload for spine surgeons. So far, there is still a debate about the term "extreme lateral," and in general, it describes the intra - and extraforaminal position of the disc herniation. We present a surgical treated case series in which the disc herniation on the lumbar spine was still ventral of the exiting nerve root far outside of the foramen.

Methods: Study Design and Patient Characteristics: retrospective analysis of 14 surgical treated patients. Surgical Technique: In all patients, the so-called foraminal retreat maneuver (percutaneous endoscopic lumbar discectomy) was performed. A foraminoscope with a 15° optic orientation and a nonbeveled working sleeve were used in all cases. The aforementioned technique represents a modification of the "inside-out" endoscopic surgery on the lumbar spine.

Results: We treated 11 male and 3 female patients with an average age of 67 years and 66 years, respectively. Except for one, 13 patients presented with clear monoradicular symptoms accompanied by mild-to-moderate neurological deficits. In 11 cases, the disc herniation exhibited cranial migration; two were at the disc level, and in another case, caudal migration was observed. Immediate pain relief and significant improvement of neurological symptoms occurred in all patients. Two patients developed neuropathic pain, which improved after conservative treatment within 6 weeks following the procedure. No recurrence was observed in this case series.

Conclusion: Patients suffering from extreme lateral lumbar disc herniation were found to be significantly older. Furthermore, there is a higher tendency toward male patients and cranial migration of the herniation. The described and modified inside-out technique, along with a 15° optic, allows for clear identification of the exiting nerve root and safe removal of the displaced disc herniation far outside of the spinal canal and foramen. No complications occurred in this small series, and the development of neuropathic pain appears to be relatively common.

Keywords: Endoscope, Extreme lateral, Lumbar disc herniation, Transforaminal

INTRODUCTION

In 1974, Abdullah *et al.* were the first to describe an extreme lateral lumbar disc herniation.[1] The diagnosis was confirmed by discography, with the herniation located within the foramen. With the advent of computed tomography (CT) and magnetic resonance imaging (MRI), further case reports detailing more lateral extraforaminal localization were published.[8,27] Nowadays,

the term "extreme lateral" is used for both intra- and extraforaminal disc herniation. We propose that the term "extreme lateral" should be reserved for lumbar sequestration lying extraforaminal and anterior to the exiting nerve root [Figure 1].

At present, there are no case series or research articles in the common and recent literature addressing this specific type of lumbar disc herniation. Far lateral disc herniation (FLDH) constitutes a minor portion of the total discectomy workload for spine surgeons. The overall incidence ranged from 3% to 12% of all lateral disc herniation (LDH).[4,19] Due to their different anatomical positioning compared to the more common paramedian disc herniation, the surgical procedures involved in releasing the neural compression caused by FLDHs are often challenging and frustrating to most spine surgeons, resulting in suboptimal outcomes for the patient. This is related to the higher risk of spinal instability from facet joint disruption and may even be associated with nerve root injury.[2]

Far lateral LDH presents with some unique clinical features. First, it often occurs in older patients, with a peak age in the sixth decade.[19,23] It usually has a more acute onset and causes more severe radicular pain due to direct pressure on the dorsal root ganglion.[20] Furthermore, it occurs more frequently at the upper lumbar levels and is commonly associated with intracanalicular LDH or stenosis.[23] Finally, the surgical outcomes of foraminal or far lateral LDH are less favorable than those of central or subarticular LDH.[3]

MATERIALS AND METHODS

Study design and patient characteristics

Retrospective analysis of 14 surgical treated patients (from May 2016 to April 2024). All patients provided informed consent to be included in this case series, and all of them, the same surgical technique was applied. Imaging findings of all patients and the diagnosis of an extreme lateral disc herniation are documented in Figure 2.

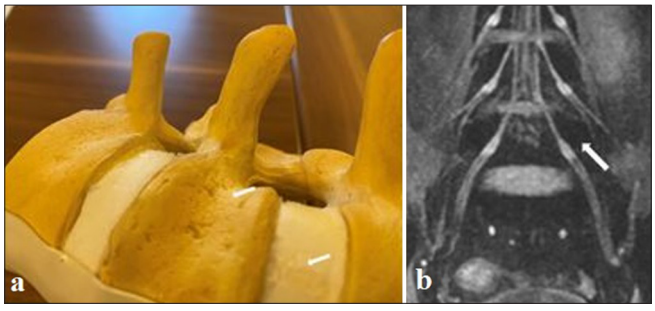

Figure 1: (a,b): White arrows show the extreme lateral position of the disc herniation at the disc level or with cranial migration.

Surgical technique

The surgical intervention employed percutaneous endoscopic lumbar discectomy. In all patients, the so-called foraminal retreat maneuver was performed.[12]

Surgical technique steps:

1. The procedures were performed with the patients under general anesthesia in the prone position with slightly flexed hips and knees on the Wilson frame. Nerve root monitoring through free-run electromyography (EMG) or stimulated EMG was done sometimes but not routinely.[24]
2. Guided by the C-arm in two planes, the puncture of the intervertebral disc with a discography needle targeting the central part through Kambin's triangle was performed.
3. After the insertion of the needle, discography was conducted
4. A guide wire was inserted through the needle channel into the disc, and a small stab incision was made at the entry site of the needle
5. After withdrawing the needle, a conical dilatator was slid over the guide wire and advanced into the disc space
6. After insertion of the working sleeve and endoscope, internal decompression of the disc was performed
7. After the internal decompression, the working cannula was pulled out from the central disc space to the foramen. The nonbeveled tip of the working cannula was positioned in the cephalad and lateral direction close to the posterior wall of the vertebra ("foraminal retreat"), serving as a retractor to the more ventral mobilized exiting nerve root also.[13]
8. In the case of cranial migration of the sequester, the edge of the lateral caudal endplate was exposed to enter the lateral concavity of the vertebral body and to visualize the herniation [Figures 3 and 4].

RESULTS

The distribution along the lumbar spine was as follows: two patients at L5/S1, eight patients at L4/5, three patients at L3/4, and finally, one patient at L2/3. We treated 11 male and 3 female patients with an average age of 67 years and 66 years, respectively. Except for one,[14] 13 patients presented with clear monoradicular symptoms accompanied by mild-to-moderate neurological deficits. In eleven cases, the disc herniation exhibited cranial migration; two were at the disc level, and in one further case, caudal migration was observed [Figure 5].

Immediate pain relief and significant improvement of neurological symptoms occurred in all patients. Two patients developed neuropathic pain, which improved after conservative treatment within 6 weeks following the

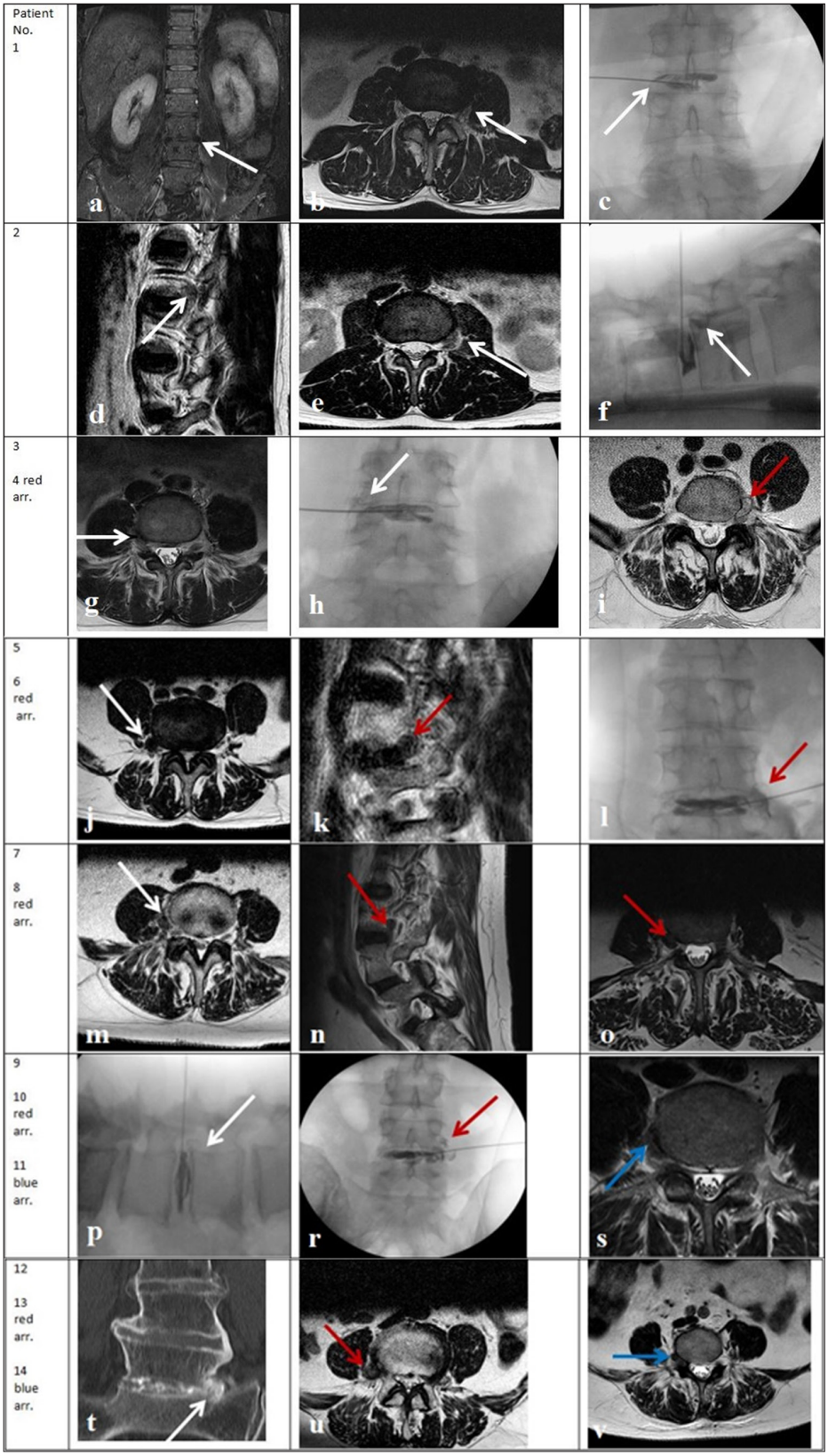

Figure 2: (a-v): Imaging findings of the surgical treated patients. The locations of sequestered discs in radiological images are shown with white, blue, and red arrows.

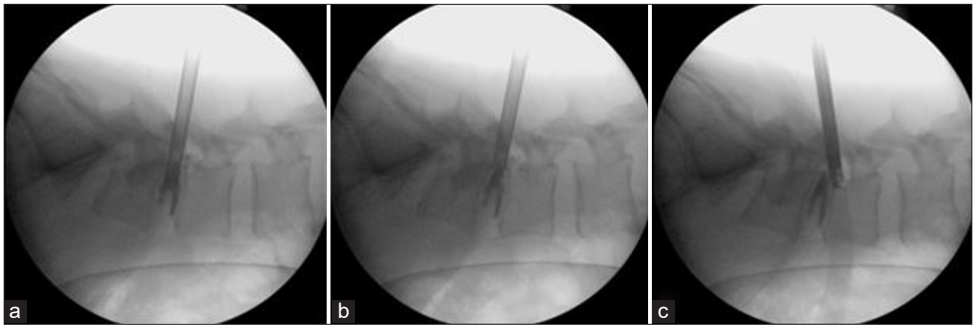

Figure 3: (a-c) Intraoperative X-ray documentation of the foraminal retreat maneuver starting in the center of the disc.

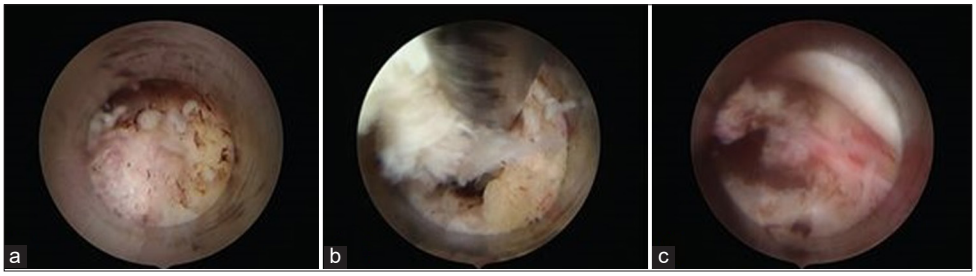

Figure 4: (a) Endoscopic view of the Kambin triangle after resection of soft tissue, (b) mobilizing the cranial migrated disc herniation with a hook and (c) released exiting nerve root covering the concavity of the lateral vertebral body.

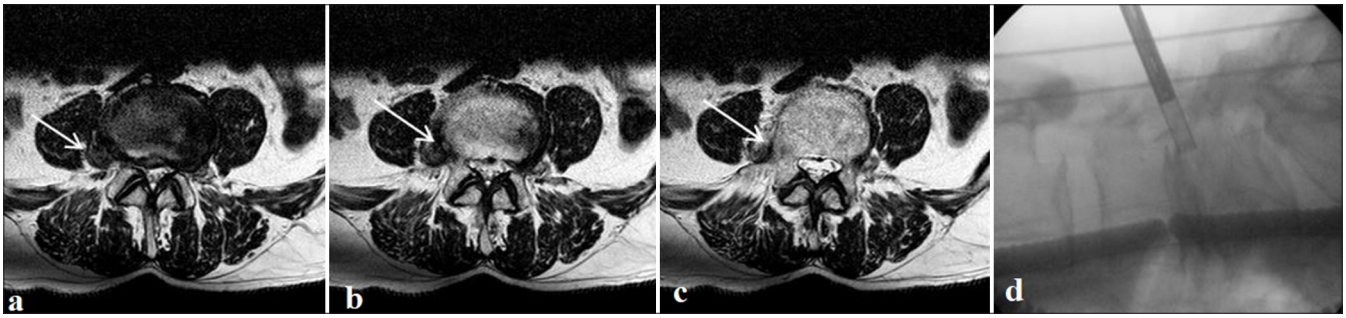

Figure 5: (a-d) Extreme rare case of extraforaminal caudal migration L4/5. Caudal orientation of the working sleeve and the endoscope. White arrows in a-c show the sequestered disc.

procedure. No recurrence was observed in this case series [Table 1].

Patient No. 12 was suffering from acute left leg pain and L5 radiculopathy, followed by mild neurological deficits. MRI in the disc level L4/5 was inconspicuous, and in axial T2 weight images, a presacral luxation was supposed. The diagnosis was confirmed by discography with connected CT of the lumbosacral level, followed by multiplanar reconstruction in the selected bone window [Figure 6].

DISCUSSION

FLDH is defined as a disc herniation located on the sagittal plane laterally to the medial wall of the pedicle.[1,6] This definition is also made as extra-canalicular, extreme lateral, and extraforaminal lumbar disc herniation (ELDH) and describes the same pathology.[15] The latter types of herniation ELDH are responsible for nerve root compression at the level of or beyond the dorsal ganglion, where the root emerges from the foraminal canal. Assessing the precise position of the disc herniation beyond the foramen is important for surgeons who must choose the appropriate surgical approach. However, there are difficulties in making a correct diagnosis before surgery because careful observations of the extraforaminal zone are often lacking, and the extent of scanning (MRI, CT) on the sagittal plane and slice thickness of the axial plane is limited. Moreover, a coexisting intraspinal pathology can obscure a diagnosis of far lateral entrapment of the lumbar spinal nerve. Furthermore, there

Table 1: Patient characteristics, clinical and imaging findings.

No. Pat. No No.	Sex	Age years	Level	Time f. Surgery min.	Clinical findings preop	Clinical findings postop at discharge	Imaging findings
1	male	66	L3/4 left	82	Hip flex. 2/5, Knee ext. 2/5, Painfull L3	Improvement to 5/5, Painfree	Diagnosis was made by MRI (T2 axial and T1 coronal), confirmed by discography, disc level
2	male	54	L2/3 left	44	Painfull L2, No neurological deficits	Nearly painfree, Sensitivity L2 reduced	Diagnosis was made by MRI (T2 sagittal and axial), confirmed by discography, cranial migration
3	female	55	L4/5 right	28	Painfull L4, Knee ext. 4/5, Dysesthesia L4	Neuropathic pain syndrom for 6 weeks, MRI revealed no recurrence	Diagnosis was made by MRI (T2 sagittal and axial), confirmed by discography, cranial migration
4	male	56	L5/S1 left	41	Painfull L5, Foot - and tooth ext. 3/5	Nearly painfree, only slight improvement of the paresis	Diagnosis was made by MRI. Early recurrence (within 6 weeks) after previous PELD (T2 sagittal and axial), cranial migration
5	male	83	L4/5 right	36	Painfull L4 proximal, Knee ext. 4/5	Nearly painfree, Knee ext. 5/5	Diagnosis was made by MRI (T2 sagittal and axial), cranial migration
6	male	65	L4/5 right	33	Painfull L4, Sensitivity L4 distal reduced	Neuropathic pain L4 improved after conservative treatment	Diagnosis was made by MRI (T2 sagittal and T1 axial), confirmed by discography , cranial migration
7	male	75	L4/5 right	58	Painfull L4, Knee ext. 3/5	Painfree, No motor deficit	Diagnosis was made by MRI (T2 sagittal and T1 coronal), confirmed by discography, cranial migration
8	male	68	L3/4 right	20	Painfull L3, Knee ext. 4/5, Hip flex. 4/5	Painfree, No motor deficit	Diagnosis was made by MRI (T2 sagittal and axial) cranial migration
9	male	70	L3/4 right	38	Painfull L3, Knee ext. 4/5, Hip flex. 4/5	Painfree, No motor deficit	Diagnosis was made by MRI (T2 sagittal and axial), confirmed by discography, cranial migration
10	male	46	L4/5 left	22	Painfull L4, Knee ext. 4/5, Dysesthesia L4	Painfree, No motor deficit, Dysesthesia improved	Diagnosis was made by MRI (T2 sagittal and axial), confirmed by discography, cranial migration,
11	male	56	L4/5 right	55	No clear radicular symptoms	Painfree	Diagnosis was made by MRI, coronal STIR with compression of peripheral L3 nerve, cranial migration
12	female	72	L5/S1 left	36	Painfull L5, Foot - and tooth ext. 3/5	Nearly painfree, No motor deficit	Diagnosis was made by discography and CT after discography, presacral migration
13	male	82	L4/5 right	55	Painfull L4, Foot ext. 3/5	Painfree, No motor deficit	Diagnosis was made by MRI (T2 sagittal and axial), confirmed by discography, caudal migration
14	female	72	L4/5 right,	17	Painfull L4	Painfree	Diagnosis was made by MRI (T2 sagittal and axial), confirmed by discography, cranial migration, late recurrence (7 years) after previous PELD

Figure 6: (a-c) Diagnosis of presacral luxation of a sequester (white arrows) on figures a,b,c, was confirmed by CT-discography with positive radiography of the displaced and compressed L5 - nerve root (red arrow) on figure c.

are no reports on the characteristics and reliable MRI findings of extraforaminal disc herniation.[15] In a case series of 18 patients, Kaya *et al*. found that a total of 15 (84%) patients had upper migration, and three (16%) had FLDH in the disc distance. A distinction between intraforaminal and extraforaminal was not made, and a microsurgical midline approach treated all patients. In the case of cranial migration, the lateral surface of the pars interarticularis was drilled.[10] A clear anatomical division of the extraforaminal zone anterior to the exiting nerve root is also missing, and the migration of the fragments is observed to be toward the psoas muscle.[21] Very rarely, these dislocations can mimic an abscess within the psoas muscle.[9]

Nowadays, the transforaminal endoscopic, percutaneous discectomy method is becoming increasingly widespread. Successful results are reported with this minimally invasive technique.[16,18,19] Its popularity is increasing with its short operation time, low bleeding, shorter postoperative recovery period, low complications, and high success rates. In addition, it has been suggested as an effective and reliable method in patients with recurrent lumbar disc herniation who require surgical treatment and do not have segmental instability.[16]

In a summary of surgical treated far lateral lumbar disc herniation reported as suspicious for nerve sheath tumors, Uy BR *et al*. presented two own cases and five separate published case reports. In three of them, the dorsal approach was chosen, and a hemilaminectomy paired with a complete facetectomy was performed. In two cases, transposase access in a lateral decubitus position was elected, and finally, in two patients, an anterior transperitoneal or retroperitoneal approach was selected.[26] The anterior transperitoneal approach was done in a female patient with an extreme lateral presacral disc herniation L5/S1, very similar to our patient number 12.[11] In another publication on ELDH at L5/S1 with caudal migration, the presacral L-5 root was explored through a microsurgical lateral extraforaminal transmuscular approach.[25]

Although some scientific and technical descriptions in the literature on full endoscopic treatment of extreme lateral lumbar disc herniation can be found, details of different dislocations in the extraforaminal compartments are not taken into account.[5,17,28]

Paramedian lumbar disc herniations are generally reported in the 30–50 age range.[7,10,20,22] Patients suffering from extreme lateral lumbar disc herniation were found to be significantly older in parallel with our study.[7,10,19]

Limitations of this study include its retrospective nature. In addition, later examinations and a clinical follow-up of the patients were not carried out.

However, the technology described here allows different alignments of the working sleeves outside the foramen to secure the safe identification of the nerve roots and the unusually far lateral migrated sequester. In contrast to the very heterogeneous open surgical approaches, this presented percutaneous endoscopic technique is, to our knowledge, the first minimal invasive access dealing with very demanding and complex disc pathologies on the lumbar spine.

CONCLUSION

Patients suffering from extreme lateral lumbar disc herniation were found to be significantly older compared to the general occurrence in the population of symptomatic lumbar disc herniation. Furthermore, there is a higher tendency toward male patients and cranial migration of the herniation. The modified inside-out technique, described as the foraminal retreat maneuver, along with a 15° optic, allows for clear identification of the exiting nerve root and safe removal of the displaced disc herniation far outside of the spinal canal and foramen. No complications occurred in this small series, and the development of neuropathic pain appears to be relatively common. The distribution along the lumbar spine shows no major deviations.

Authors' contributions: Luebbers and Baalmann performed the surgeries and collected data. They also discussed the

technique. Ali and Kale summarized and discussed the clinical data.

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Conflicts of interest: There are no conflicts of interest.
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