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# Foraminal and far lateral lumbar disc herniation: outcome of unilateral full facetectomy with instrumented fusion

Ahmed Gabry Elnaggar<sup>1\*</sup> and Hosam Abdel-Azim Habib<sup>1</sup>

## Abstract

**Background** Far lateral lumbar disc herniation is a clinical condition characterized by nerve root compression out of the spinal canal, in its extraforaminal/extracanalicular course at the inferior or lateral aspect of the facet joint.

**Objective** To analyze the effect of unilateral full facetectomy with instrumented fusion in management of foraminal and far lateral lumbar disc herniation.

**Methods** This retrospective trial carried out on 34 cases (24 males, 10 females) aged from 27 to 68, with mean value of 49 years who were entered to the Neurosurgery Department, Menoufia University Hospital from January 2018 and January 2022. All patients suffered from foraminal and/or far lateral lumbar disc herniation and were treated with unilateral full facetectomy with instrumented fusion.

**Results** The herniation level was at L2-3, L3-4, L4-5, and L5-S1 in 2, 10, 18, and 4 patients, respectively. Overall, the mean preoperative VAS score decreased from 8.6 to 2.3 in the short-term. When the long-term functional outcome following surgery was analyzed according to the MacNab Criteria, the recovery was excellent, good, fair, and poor in 26, 8, 0, and 0, respectively.

**Conclusions** Full facetectomy ± laminectomy technique provides direct visualization of the complete course of the nerve root extending far laterally to avoid missed disc fragments and protect the nerve root from inadvertent trauma. Pedicle fixation for stabilization following full facetectomy has been indicated to avoid postoperative pain syndromes due to 'micro-instability'.

**Keywords** Lumbar disc herniation, Far lateral, Fixation, Transpedicular screws

## Introduction

The 'far lateral' compartment is described anatomically as the region lateral to the superior and inferior pedicles, with the disc located anteriorly and the vertebral body and leading edge of the superior articular facet medially with the facet joint itself located dorsally [1]. Far lateral lumbar disc herniation (FLLDH) is a clinical condition

characterized by nerve root compression out of the spinal canal, in its extraforaminal/extracanalicular course at the inferior or lateral aspect of the facet joint [2].

Hood reported that FLLDH represents 3–10% of all disc herniations [3]. Pure foraminal lesions, located subarticularly bounded by the lateral and medial superior pedicle, are present in 3% of disc herniations, with intra and extraforaminal extension observed in 4% [4]. FLLDH found most frequently at the L3-L4 or L4-L5 site, then the L5-S1 site [5]. High lumbar affection of L1-L2 or L2-L3 is relatively uncommon although An et al. [6] research stated a relatively high prevalence of 28%.

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In contrast to disc herniations within the canal, the FLLDH offends the ganglion and nerve root exiting superiorly, where L1-L2 disc herniations generate a deficit in the L1 root spreading, whereas L2-L3 disc herniations result in L2 root deficits, L3-L4 disc herniations lead to L3 root complaints, L4-L5 disc herniations result in L4 deficits, and L5-S1 lesions are cause L5 root compromise [1].

Symptoms of FLLDH may manifest suddenly. In FLLDH, likely because to sequestered nucleus fragments with direct dorsal root ganglion compression, causing acute severe radicular pain [7].

The majority of patients report that back pain is the primary complaint, then radicular discomfort, paresthesia and diminished sensation. Generally, the low back pain recedes with progression of the radicular pains. Pain is usually aggravated by hip extension or lateral flexion ipsilateral to the disc herniation. However, Ninety percent of the patients have a negative straight leg raise test [8].

The MRI is the most sensitive imaging modality for identifying FLLDH. MRIs of the sagittal and parasagittal planes may indicate disc material obstructing the neural foramen. It is essential, therefore, that the parasagittal views contain the neuronal foramina. The absence of fat might indicate a herniated disc and contrast enhanced MRI helps distinguish FLLDH (non-enhancing) from tumors [9].

Various surgical techniques have been proposed for the management of FLLDH. The techniques for discectomy include medial facetectomy, full facetectomy, intertransverse extreme lateral approach and transforaminal endoscopic methods. The amount and kind of facet excision and decompression used to treat FLLDH must be personalized, as there is no universally applicable procedure.

### Objectives

To analyze the effect of unilateral full facetectomy with instrumented fusion in management of foraminal and far lateral lumbar disc herniation.

### Patients and methods

This retrospective trial carried out on 34 cases (24 males, 10 women) aged from 27 to 68, with mean value of 49 years who were entered to the Neurosurgery Department, Menoufia University Hospital from January 2018 and January 2022.

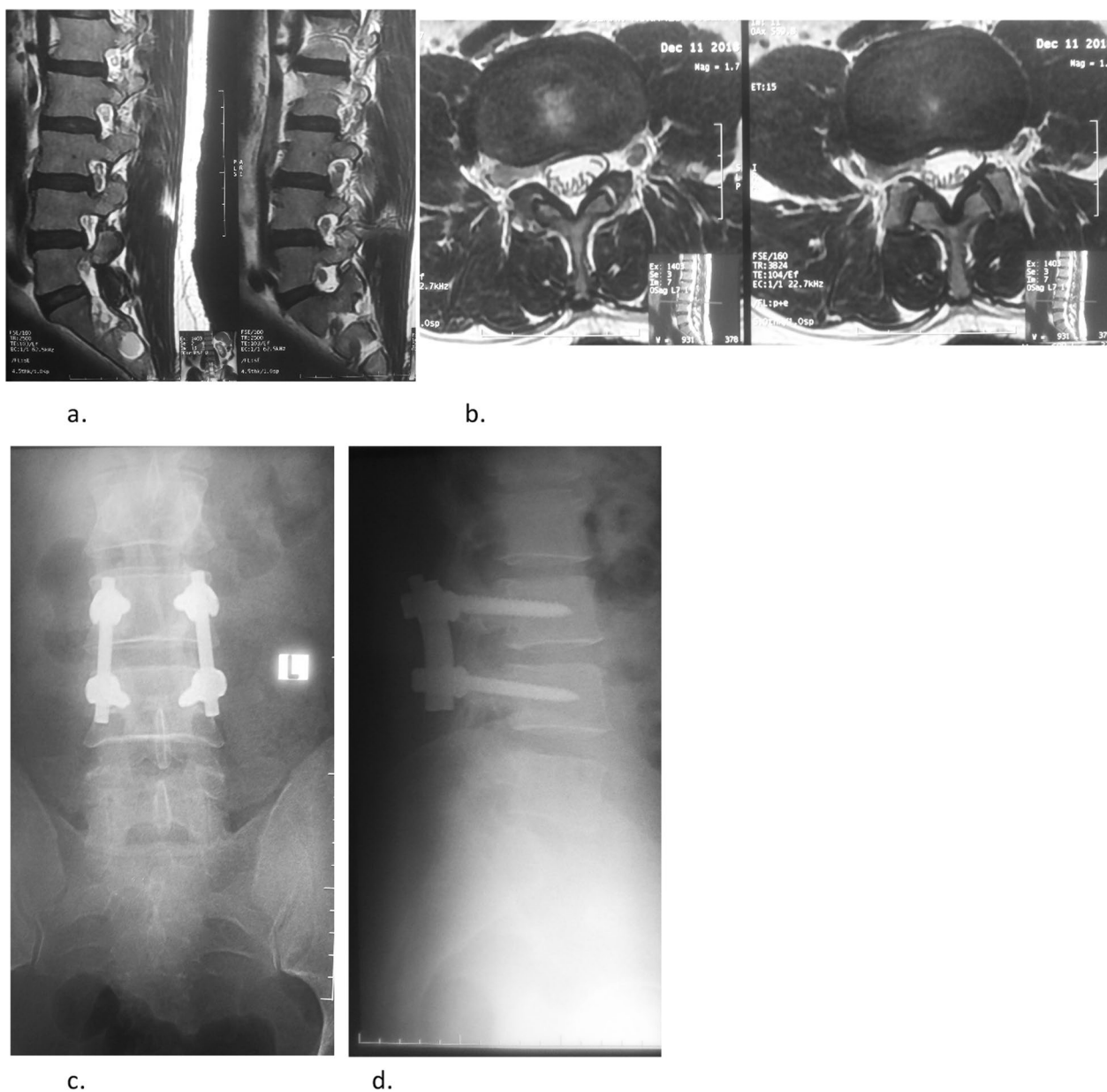
Following a succinct and clear explanation of the study's objectives, all participants gave signed informed permission. The consent form was designed in accordance with the Declaration of Helsinki and the standards of the Egyptian Ministry of Health's Quality and Improvement System. The study plan was approved by the local ethical scientific committee of the Menoufia

Faculty of Medicine, Menoufia, Egypt (ID: 7/2022NEUS 9-1) (Figs. 1, 2, 3 and 4).

- Inclusion criteria
  - (a) The presence of unilateral foraminal or extraforaminal disc herniation on MRI.
  - (b) Spontaneous radicular pain in conformity with the radiological results.
  - (c) Failure to respond to conservative management or evolving motor deficit.
  
- Exclusion criteria
  - (a) Case with bilateral neurogenic claudication.
  - (b) Previous disc surgery at the same level.
  - (c) Radiological instability at the same level.

The data retrieved from the records included the pre-operative assessment, clinical examination, neurological findings, and deficits of the patients, as well as the pre-operative and postoperative (immediate postoperative, Three-, six-, and twelve-month evaluations) visual analogue scale for pain, the radiological findings (MRI and the dynamic X rays), blood loss and surgical duration.

All patients were operated upon under general anesthesia in a prone position. C-arm fluoroscopic guidance was performed for all the cases to confirm the operative level. A midline incision was performed followed by subperiosteal paravertebral muscle stripping, till the facet roofing the foramen of interest was exposed. Whenever feasible, limited laminectomy was performed unless the patient was stenotic; full laminectomy was done. Ligamentum flavum along with inferior aspect of the lamina above and the attached inferior facet was excised followed by excision of the superior facet; at this point, the operative microscope is introduced to the field to allow proper visualization of the offended root which is located above the herniated disc. Discectomy is commenced till adequate decompression has been accomplished; Finally, bilateral transpedicular screw fixation was performed in all cases. Interbody cage for fusion was inserted additionally to achieve solid bone fusion and avoid construct failure in 22 cases, while in the other 12 cases, interbody bone fusion was done only because the disc space was too narrow or the bony endplate was breached and violated during curettage, so the cage was avoided to prevent sinking of cage in cancellous bone of the vertebral body.



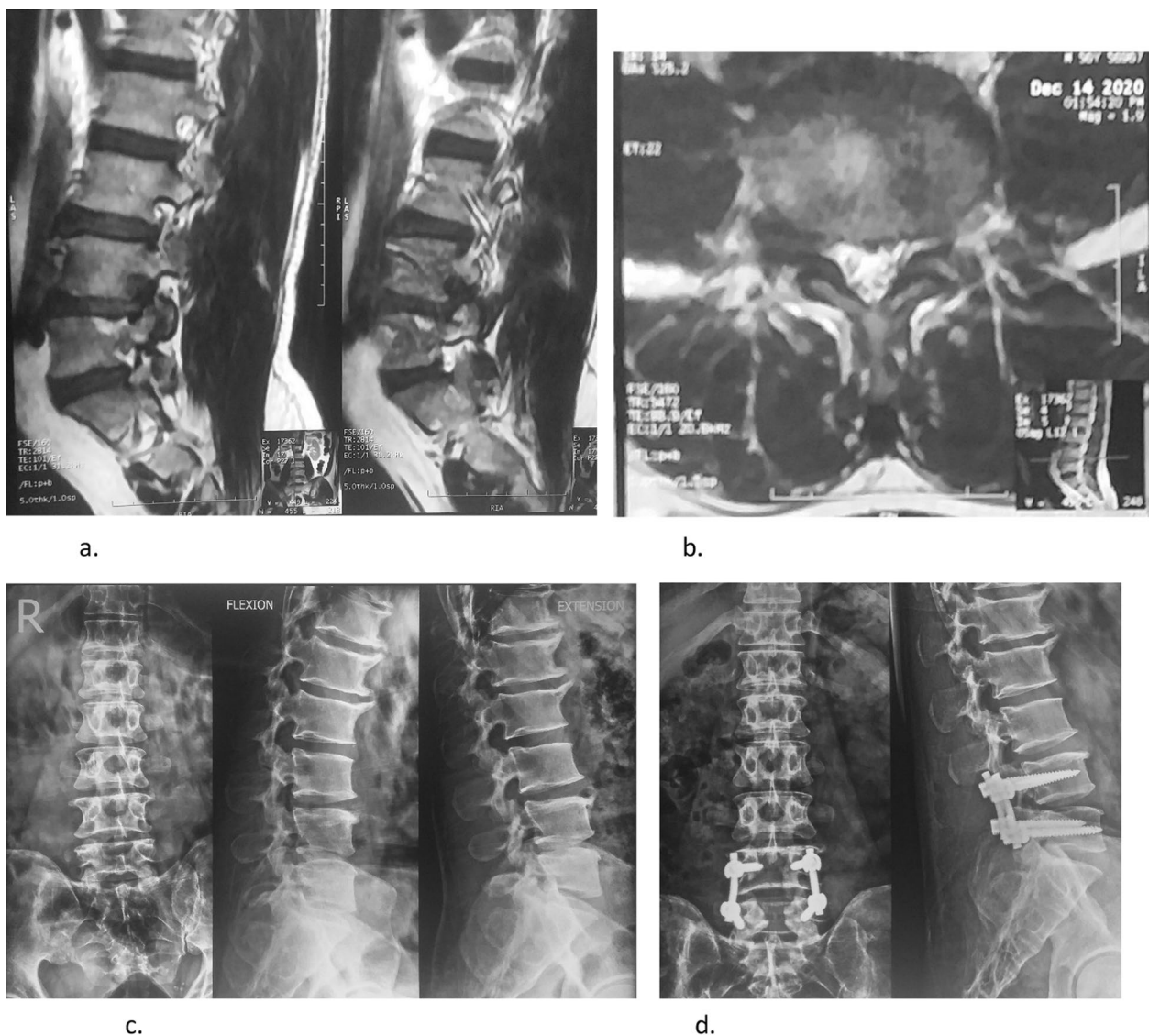
**Fig. 1** Rt L3-4 FLLDH. Male patient 43 y old presented with Rt femoralgia and weakness of the quadriceps muscle. **a** and **b** preoperative MRI LSS axial and sagittal views showed L3-4 Rt foraminal and far lateral LDP compressing Rt L3 root. **c** and **d** postoperative X Ray LSS. surgical treatment was done with L3-4 laminectomy and Rt L3-4 full facetectomy, discectomy and removal of the extruded fragment, and L3-4 fixation with transpedicular screws. Marked improvement of pain and weakness was observed immediately postoperatively (Excellent outcome)

All patients were immediately mobilized postoperatively with an external lumbosacral orthosis. Blood loss and surgical duration were documented. Patients were discharged within three days postoperatively with treatment for two weeks of oral antibiotics.

Immediate postoperative VAS assessment for radicular pain and neurologic assessment was repeated. Follow-up evaluation was done at 3 and 6 weeks then after 3-, 6- and

12-months. VAS was evaluated again at the time of final follow-up. The differences in preoperative and final follow-up VAS were checked statistically by Student t test, and a value of <0.05 was considered significant.

Radiological follow-up: Immediate postoperative Plain-X ray was performed to confirm the accurate position of pedicular screws and interbody cage and repeated



**Fig. 2** Rt L4-5 foraminal and FLLDH. Male patient 38 y old presented with severe Rt sciatica. **a** and **b** preoperative MRI LSS sagittal and axial views showed L4-5 Rt foraminal and far lateral LDP compressing Rt L4 root. **c** preoperative Dynamic X Ray LSS, stable. **d** Postoperative X Ray LSS; surgical treatment was done with L4-5 laminectomy and Rt L4-5 full facetectomy, discectomy and removal of the extruded fragment, and L4-5 fixation with transpedicular screws. Marked improvement of pain was observed immediately postoperatively (Excellent outcome)

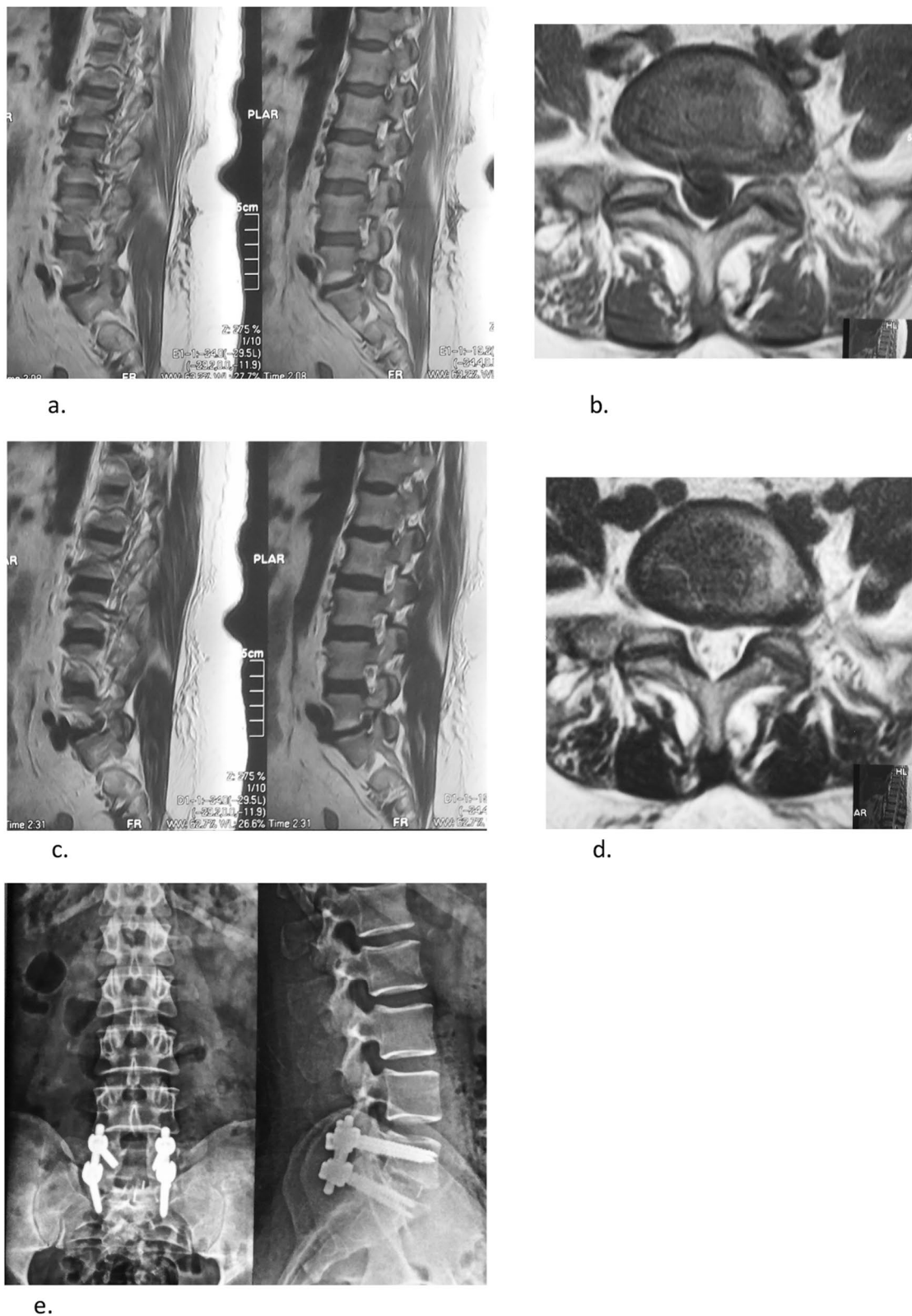
6 months postoperatively and at the end of the study for assessment of successful fusion.

Surgical result was categorized by MacNab’s classification: Excellent: total back and leg pain relief. Good: occasional back/leg pain. Fair: Pain in the back and legs improves marginally with occasional usage of pain medication. Poor: there is little or no improvement in pain, or it is worse than before surgery, With consistent pain medication use [10].

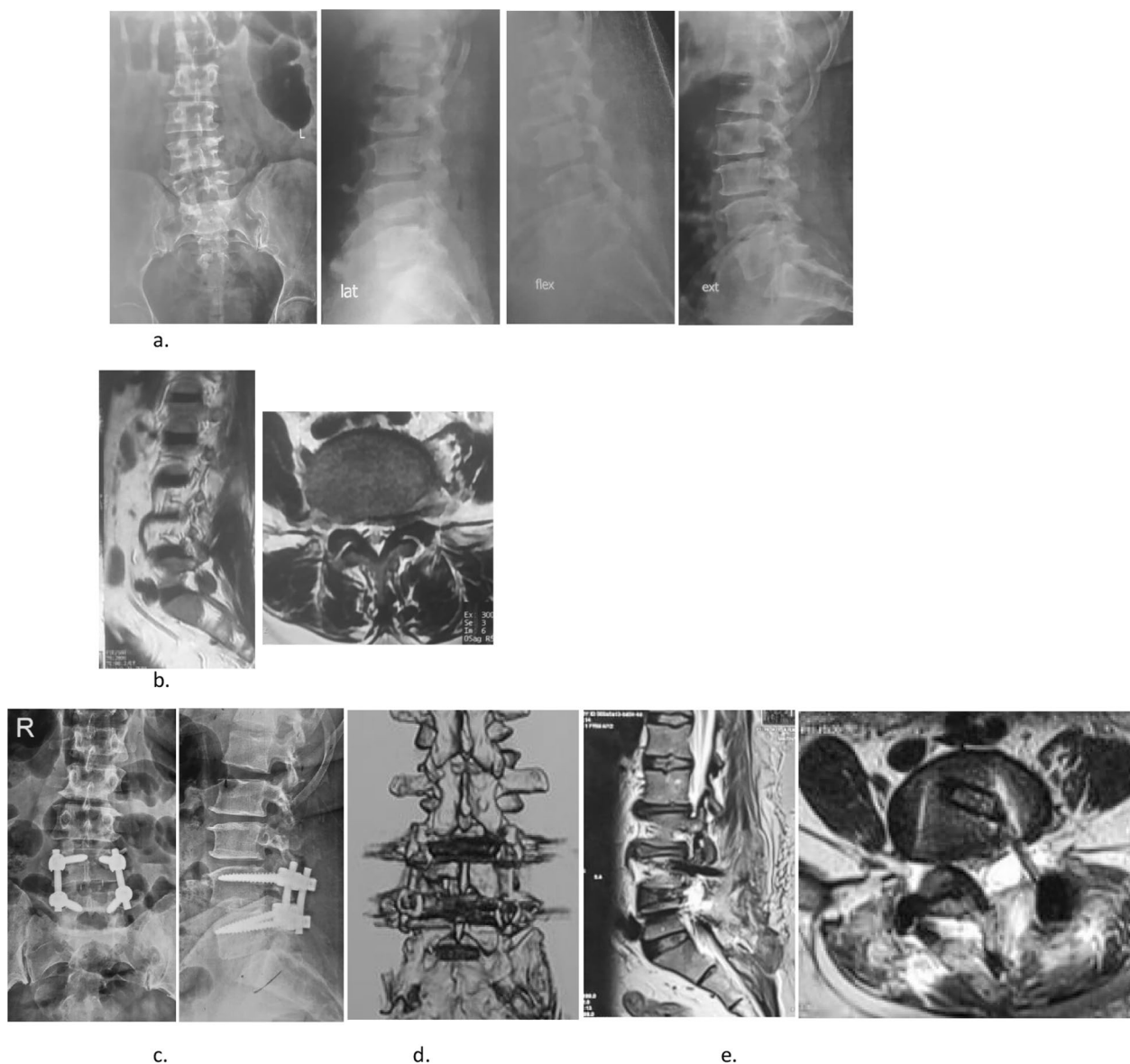
**Results**

Between January 2018 and January 2022, 34 patients (24 males, 10 females) with a mean age of 49 years (range: 27–68) were operated on for FLLDH. The radicular pain was femoralgia in 12 cases, sciatica in 10 cases, and both in 12 cases. The herniation level was at L2-3, L3-4, L4-5, and L5-S1 in 2, 10, 18, and 4 patients, respectively.

All patients included in the study, underwent laminectomy and unilateral facetectomy, discectomy and transpedicular screws with single-level fusion. Overall, the mean operation duration was 85 ± 12 min. Overall, the



**Fig. 3** L5-S1 Lt FLLDH. Female patient 42 y old presented with severe Lt sciatica. **a** and **b** preoperative MRI LSS sagittal and axial views T1, **c** and **d** preoperative MRI LSS sagittal and axial views T2, showed L5-S1 Lt foraminal and FLLDH compressing Lt L5 root. **e** Postoperative X Ray LSS; surgical treatment was done with L5 laminectomy and Lt L5-S1 facetectomy, discectomy and removal of the extruded fragment, and L5-S1 fixation with transpedicular screws. Marked improvement of pain was observed immediately postoperatively (Excellent outcome)



**Fig. 4** L4-5 Lt FLLDH. Female patient 38 y old presented with severe Lt sciatica. preoperative dynamic X Ray LSS (a), and preoperative MRI LSS sagittal and axial views T2 (b) showed L4-5 Lt far lateral LDP compressing Lt L4 root. surgical treatment was done with Lt L4 hemilaminectomy and Lt L4-5 facetectomy, discectomy and removal of the extruded fragment, insertion of L4-5 cage and L4-5 fixation with transpedicular screws. postoperatively, the sciatica was completely recovered with excellent outcome. postoperative X Ray LSS A-P and lateral views (c), Postoperative CT LSS (d), Postoperative MRI LSS (e) showed L4-5 Lt hemilaminectomy, Lt facetectomy, L4-5 cage and L4-5 fixation with transpedicular screws and good decompression of the Lt L4 root

mean blood loss was  $200 \pm 50$  mL. No blood transfusions were required at any time.

Overall, the mean preoperative VAS score decreased from 8.6 to 2.3 in the short-term. When the long-term functional outcome following surgery was analyzed according to the MacNab Criteria, the recovery was excellent, good, fair, and poor in 26, 8, 0, and 0, respectively (Tables 1, 2 and 3)..

The commonest postoperative complications in our study were Superficial wound infection developed in two patients (2/34, 5.9%) and was treated conservatively by bed rest, antibiotics and daily dressing until complete healing. Transient CSF leakage was reported in one patient (1/34, 2.94%) and was managed conservatively by absolute bed rest, compressed bandage and frequent aspiration until complete resolution with no collection, as shown in Table 4.

**Table 1** Presenting symptom according to disc level

Disc level	Case no	Femoralgia	Sciatica	Femoralgia + Sciatica
L 2-3	2	2	–	–
L 3-4	10	10	–	–
L 4-5	18	–	6	12
L 5-S 1	4	–	4	–
Total	34	12	10	12

**Table 2** Outcome

Outcome	Mean preop (VAS)	Mean postop (VAS)	<i>p</i> value
VAS	8.6±0.80	2.3±0.50	<i>p</i> <0.001

**Table 3** Long-term functional outcome according to the MacNab Criteria:

Criteria	No	%
Excellent	26	76.5
Good	8	23.5
Fair	–	–
poor	–	–
Total	34	100

## Discussion

Extraforaminal FLLDH could be defined as compression of the existing nerve root by the disc of the same level, by migration of sequestered disc material superiorly and laterally into the neural foramen or further to the extraforaminal region [11]. In 1944, Lindblom demonstrated for the first time in a cadaveric study the presence of lumbar disc herniation lateral to the neural foramen [12]. In 1971, MacNab explored unsuccessfully the L4-5 level of two cases presented with L5 radicular manifestations caused by FLLDH of the L5-S1 disc level [13]. In 1974, Abdullah et al. defined the FLLDH as a clinical entity for the first time and described it on discography as 'extreme lateral' disc herniation lateral to the disc or under the facet at the same level [13].

The incidence of FLLDH ranges from 7 to 12% according to the neuroimaging investigation done [5, 14–16]. The absolute rate of occurrence is highest at the lower lumbar L4-5 and L5-S1 levels; however, the relative rate is higher at the upper lumbar L3-4 and L2-3 levels [5, 17]. Anatomically, with caudal progression of the lumbar spine, the pedicles diverge and their long axis orientation changes so the extraforaminal space is proportionally larger in the upper lumbar spine explaining the higher relative frequency of extreme lateral disc herniation [18].

**Table 4** Postoperative complications included in the study:

Complications	No	%
Wound infection	2	5.88
Transient CSF leakage	1	2.94
Total	3	8.82

In FLLDH, the radicular pain is particularly severe, due to direct compression of the dorsal root ganglion by the sequestered disc fragments [7]. In our series, the mean preoperative VAS score was high (8.6±0.9). FLLDH compress frequently the upper lumbar nerve roots leading to femoral neuropathy and positive femoral stretch test [19]. In one series, this rate was 75% [20]. In our series, the rate of L4 and upper lumbar nerve root compression was 70.5% (24/34). Provocative tests, such as femoral stretch test, were positive in 63%. In these cases, the Lasègue test was less reliable for localizing nerve root compression; however, it is not always normal [17]; of our patients, 12/34 (35%) had positive Lasègue-assisted femoralgia. Except for the 4/34 cases with L5-S1 pathology (11.75%), only 6/34 cases with L4-L5 had sciatica alone (17.6%). Abdullah et al. [13] documented that 4% were positive Lasègue test, despite no patients had L5 root compression. In our study, 18/34 (53%) cases had motor deficits. Quadriceps femoris (14/34, 41.2% of cases) and iliopsoas (4/34, 11.8% of cases) muscle weakness was the most prevalent symptom.

FLLDH usually cannot be detected with myelography. With the advancement of MRI, neurosurgeons could diagnose FLLDH compressing nerve root at the neural foramen outlet, imitating the clinical manifestations of the paramedian disc herniation at the upper level [17]. In our series, all patients had MRI. Sagittal MRI images that pass through the foramen level is the mainstay of diagnosis of FLLDH, revealing the sequestered disc fragment. The extraforaminal fat surrounding the nerve root provides information about the foramen opening.

Conservative management in the form of non-steroidal anti-inflammatory drugs and steroids may success in treatment of patients suffering from FLLDH. Rust and Olivero reported that 71% (12/17) patients with FLLDH improved medically without surgery [21]. Weiner and Fraser reported immediate relief in 27 out of 30 cases and long-term relief in 22 out of 28 cases, after transforaminal injection of steroids and local anaesthetic while surgery was required in three patients [22]. Other series reported 10% successful conservative management [5]. However, early surgical interventions were indicated in cases with significant neural deficits.

All patients included in the study underwent laminectomy and unilateral full facetectomy, discectomy and

transpedicular screws with single-level fusion. Overall, the mean operation duration was  $85 \pm 12$  min. Overall, the mean blood loss was  $200 \pm 50$  mL. No blood transfusions were required at any time.

Full facetectomy  $\pm$  laminectomy technique is the most familiar approach provides full visualization of the complete course of the exiting nerve root posterolaterally, foraminally, extending far laterally to avoid missed disc fragments and to protect the root from inadvertent trauma.

The more facet resected, the greater the risk of instability. The full facetectomy sacrifices 100% of the inferior articular facet. According to Clinical studies, clinically symptomatic instability was relatively uncommon even after unilateral complete facetectomy. Garrido and Connaughton's series of 41 cases performed FLLDH surgery with full facet resection, required fusion in only one case [23]. In Epstein's initial series of 60 patients with FLLDH operated with full facetectomy, only one patient needed a secondary fusion [24]. Long-term follow-up has revealed more subtle postoperative pain syndromes and findings of 'micro-instability,' so elective primary fusions was indicated in the younger population.

Ahuja and Abumi et al. [25, 26] in their studies stated that removal of more than 30% of the lumbar facets results in iatrogenic segmental instability.

Hafez et al. [27] had an incidence of 77.7% of postoperative instability with mesial facetectomy especially in younger age groups and attributed this to patients returning to normal hard labor.

Pars interarticularis has an essential role in spine stability. It is thought that more drilling of the pars interarticularis will cause more instability. With increasing resection portion of the isthmus, a significant loss of resistance was occurred especially during the lateral bending loading. Fracture was significantly easier when the isthmus resected by 50% in comparison with the isthmus resected by 25% [28].

Ren et al. assessed three endoscopic techniques in the management of far lateral disc herniations, these included percutaneous endoscopic lumbar discectomy, MIS-TLIF combined with contralateral translaminar screw, and MIS-TLIF combined with bilateral pedicle screws. They concluded that fixation prevented disc recurrence [29].

The surgical outcome was categorized according to MacNab's classification: There were (26/34, 76.5%) cases with excellent outcomes, (8/34, 23.5%) cases with good outcomes, no case with fair outcomes, and no case with bad outcomes. Good to excellent outcomes were achieved in 100% of cases for the full facetectomy. FLLDH surgery had varying success rates. An et al. [6] detected a 64% prevalence of excellent. Epstein [1] described that 70% of cases who performed a full facetectomy had good to excellent outcome.

An important factor that governs the surgical technique implemented is not only the minimality of the procedures, but also the economic burden and the availability of trained personnel to perform it. Although Percutaneous extraforaminal techniques and fixation are promising techniques but are not cost efficient in developing countries for mass use.

## Conclusions

FLLDH should be considered in the differential diagnosis of severe lumbar radiculopathy. The MRI is the mainstay for identifying FLLDH. It is essential that the parasagittal views are taken far laterally to outline the neural foramina outlet. Full facetectomy  $\pm$  laminectomy technique is the most familiar approach, provides direct visualization of the complete course of the nerve root paracentrally, foraminally, extending far laterally to avoid missed disc fragments and protect the nerve root from inadvertent trauma. Pedicle fixation for stabilization following full facetectomy has been indicated to avoid postoperative pain syndromes due to 'micro-instability.'

## Abbreviations

FLLDH	Far lateral lumbar disc herniation
MRI	Magnetic resonance imaging
MIS	Minimal invasive surgery
TLIF	Transforaminal lumbar interbody fusion
VAS	Visual analogue pain scale

## Acknowledgements

Not applicable

## Author contributions

AGE carried out the clinical practice, surgical practice, data collection and analysis and contributed in writing the paper. HAAH designed the study framework, contributed in the writing process and editing, contributed in analyzing and presenting data. Both authors read and approved the final manuscript.

## Funding

No funding.

## Availability of data and materials

Available.

## Declarations

### Ethical approval and consent to participate

The study was approved by the local ethical scientific committee of the Menoufia Faculty of Medicine, Menoufia, Egypt. The Institutional Review Board (IRB) approval number and date; (ID: 7/2022NEUS 9-1).

### Consent for publication

Not applicable.

### Competing interests

The authors declare that they have no competing interests.

Received: 19 February 2023 Accepted: 16 September 2023  
Published online: 02 January 2024



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