Clinical Case Report

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Recurrent lumbar disc herniation recurrence after percutaneous endoscopic lumbar discectomy

A case report

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Abstract

Rationale: Lumbar disc herniation (LDH) is a degenerative disease and affects human health. Although percutaneous endoscopic lumbar discectomy (PELD) can redeem the living quality of patient with LDH rapidly, it appears weak to limit the recurrence rate of LDH.

Patient concerns: A 52-year-old male suffered lower back pain and lower limb paralysis for 20 years. However, conservative treatment could not relieve above-mentioned symptoms after doing heavy labor.

Diagnoses: Computed tomography (CT) revealed a disc fragment had migrated to the inferior edge of the L5 pedicle. Magnetic resonance imaging (MRI) demonstrated a type 2 Modic change (MC) at L5 and spinal canal stenosis at L4-L5. Based on these findings, the patient was diagnosed with L4-L5 disc herniation and secondary lumbar stenosis.

Interventions: The patient underwent surgery twice for PELD at L4-L5 in 1 month. Symptoms were not improved effectively until the conventional posterior discectomy with fusion was performed.

Outcomes: No signs of recurrence have been detected in 6 months of follow-up, except for mild lower back pain meeting the temperature change.

Lessons: Rapid decompression and instant therapeutic effect do not mean extending the indications of PELD. It is unreasonable to revise the recurrent LDH or treat the primary LDH with PELD under inadequate preoperative assessment.

Abbreviations: CT = computed tomography, IVD = intervertebral disc, LDH = lumbar disc herniation, MC = Modic change, MRI = magnetic resonance imaging, ODI = Oswestry Disability Index, PELD = percutaneous endoscopic lumbar discectomy, TESSYS = transforaminal endoscopic spine system, VAS = visual analog scale, YESS = Yeung Endoscopic Spine System.

Keywords: lumbar disc herniation, Modic change, recurrence, revision surgery

1. Introduction

Lumbar disc herniation (LDH) is a prevalent degenerative disease of the spine. Surgical treatment of LDH has advantages over conservative treatment.[1] The most common type of procedure used for decompression in radicular syndrome caused by LDH is nonfusion surgery. Of the nonfusion surgeries, the use of percutaneous endoscopic lumbar discectomy (PELD) has been rapidly increasing in the last decade since the introduction of fully endoscopic spine surgeries under regional anesthesia.[2,3] As a minimally invasive surgery, PELD has less bleeding volume and surgical trauma, lower anesthetic risk, and shorter hospital stay than conventional open surgery. Along with the evolvement of endoscopic surgical devices, the indications of spine endoscopy have broadened; recent studies have reported percutaneous endoscopic cervical discectomy, thoracic discectomy, lumbar stenosis discectomy, and even decompression after lumbar burst fracture.[4–6]

Leven et al[7] reported 69% patient underwent reoperation because of recurrent LDH. Although current guidelines recommend fusion surgery as a treatment for recurrent LDH,[8] nonfusion surgeries are still performed in those who have no indications of instability and deformity. Nonfusion surgery has lower financial costs than instrumented surgeries, and the short- and long-term outcomes for repeat fusion and nonfusion surgeries are similar.[9] Hence, PELD is frequently applied to revise patients with recurrent LDH whose primary surgery was PELD, due to its minimal invasion and other advantages. Furthermore, the surgical plan is sometimes influenced by patients with recurrent LDH who insist on PELD, even though it may not be the best choice.

Herein, we present the case of a patient in whom recurrent LDH occurred twice after 2 PELD procedures in 2 months. This case highlights the need for clinicians to consider the risk factors for recurrent LDH and the limitations of PELD.

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The patient has provided informed consent for publication of the case.

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2. Case report

This study was approved by the Ethics Committee and Institutional Review Board of the First Hospital of Jilin University.

A 52-year-old male with a history of lower back pain and lower limb paralysis presented at the outpatient spine surgery department. The patient had experienced 20 years of lower back pain, right leg radicular pain, and numbness along the sciatic region to the calf. The pain could be relieved by rest, analgesic medication, and physical therapies. These symptoms were exacerbated after the patient performed heavy labor 4 days ago, and the above-mentioned therapies were now unable to relieve his pain.

Physical examination revealed that the patient's body temperature was 36.3°C, blood pressure was 160/90 mm Hg, heart rate was 63 beats per minute, respiratory rate was 19 breaths per minute, and oxygen saturation was 99% while the patient was breathing ambient air. There was lumbar paravertebral muscle tenderness, and lumbar percussion at the horizontal level of the posterior superior iliac spine triggered radicular pain of the right limb. The patient's right toe back stretch strength was 3/5. There was mild sensory loss in the right lateral lower leg. The intensified straight leg rising test results of the right and left legs were 45° and 20°, respectively. There was no identifiable motion or sensory abnormalities of the perineal area. The tendon reflexes and central nervous system examination were unremarkable. The visual analog scale (VAS) for pain was 6 in the lower back, and 7 in the right leg. Routine blood testing showed a high fasting blood glucose concentration of 8.4. The patient then revealed that he had a 20-year smoking history and diabetes mellitus.

Computed tomography (CT) revealed disc herniation at L4-L5, with the disc herniated into the central spinal canal, causing ventral dural compression. The disc fragment had migrated downward and reached the inferior edge of the L5 pedicle (Fig. 1 A). Magnetic resonance imaging (MRI) revealed that the superior vertebral marrow had hyperintensity signaling on T2-weighted images, hyperintensity on T1-weighted images, which suggested a type 2 Modic change (MC) (Fig. 1B and C). MRI revealed grade IV disc degeneration in accordance with the Pfirrmann grading system, and "very high" grade disc herniation in accordance with the LDH migration grading system, which had induced stenosis at the affected level of the spinal canal (Fig. 1D). The migration and location of the herniated disc fragment was confirmed on CT. MRI also showed degeneration of the lumbar discs, Schmorl nodes at L3-L4, and disc herniation at L3-L4.

The patient was diagnosed with degeneration of the lumbar vertebral discs, L4-L5 disc herniation, L3-L4 disc herniation, secondary lumbar stenosis, and incomplete paralysis of the lower limbs. The VAS was 7, the Oswestry Disability Index (ODI) was 26, and the symptoms were seriously decreasing the patient's quality of life. Hence, discectomy was considered necessary. As the patient was being managed with several conservative therapies, and the pain was interrupting the patient's sleep, surgery was performed as soon as possible.

2.1. The first operation

After evaluating the location and migration of the herniated disc, we considered that the case met the indications for PELD. Although open surgery is recommended for far-migrated disc herniation,[10] many spine surgeons have performed migrated discectomy via the transforaminal approach.[11,12] Soon after the patient arrived, PELD was performed as described previously.[13] The total operating time was 2.5 hours, and blood loss was approximately 30 mL. During postoperative examination, the patient still reported lower back pain, but the leg pain had almost disappeared. After 5 days of continuation therapy, the VAS for the lower back and right leg were 2 and 1, respectively. The toe back stretch strength had increased to 4/5. Postoperative MRI revealed that most compression was cleared, except for the

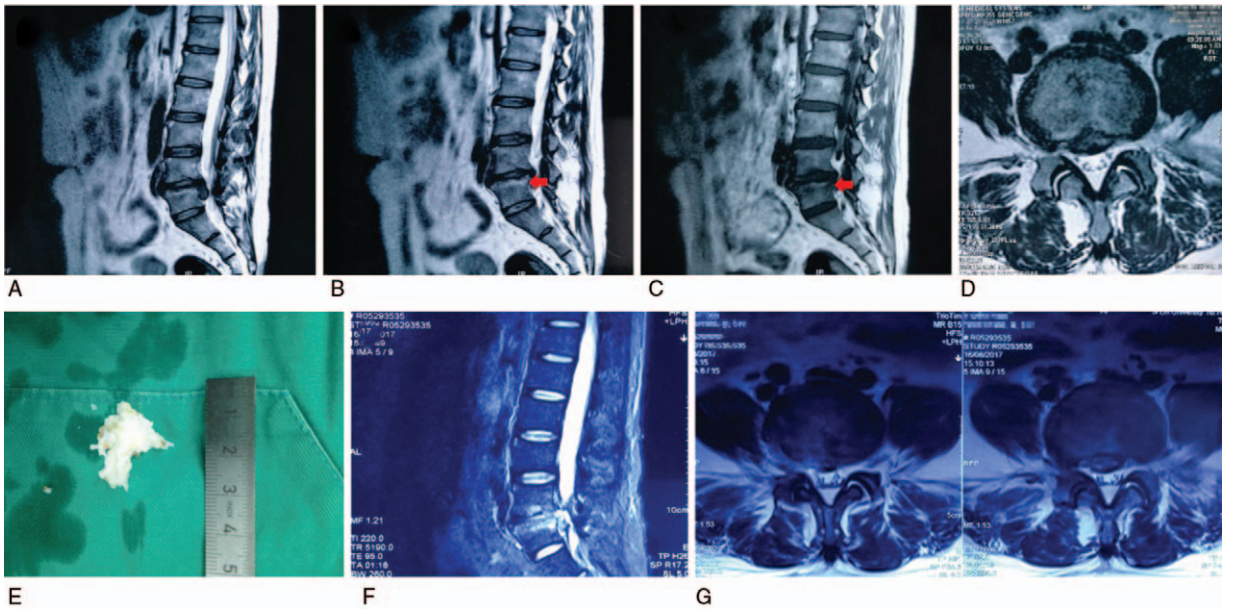

Figure 1. Pre- and postoperational magnetic resonance imaging (MRI) of first percutaneous endoscopic lumbar discectomy (PELD) demonstrated L4-L5 disc herniation and type 2 Modic change on L5 vertebrae body. A, L4-L5 disc herniation, the distal hernia reached the lower 1/3 part of L5. B, Hyperintensity on T2 weight (red arrow). C, Hyperintensity on T1 weight (red arrow). D, Axis MRI of L4-L5. E, Resected disc fragment in the first operation. F and G, Postoperative MRI showed cleared spinal canal on disc layer, but residual disc on vertebral layer.

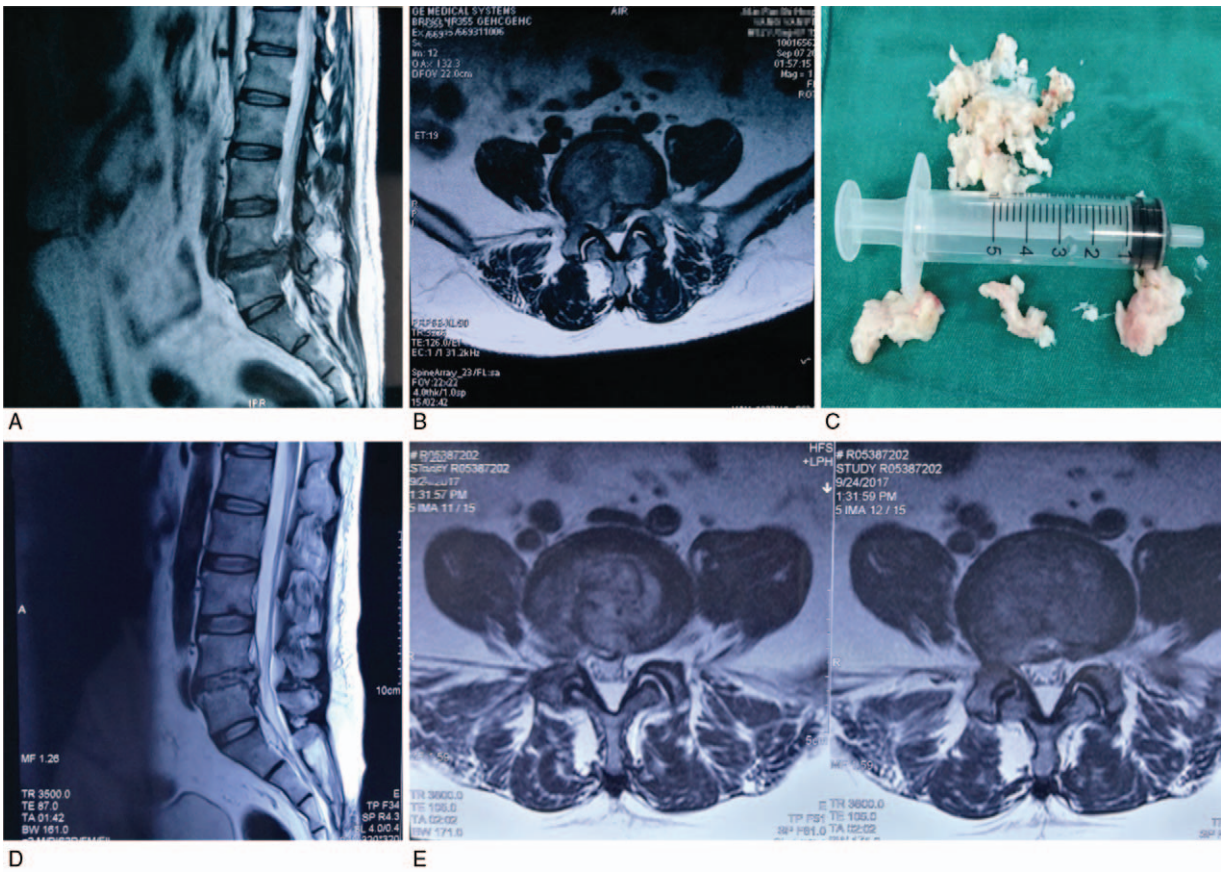

Figure 2. Pre- and postoperative MRI of second PELD. A and B, Preoperative MRI revealed recurrent disc herniation was identified on L4-L5. The right foramen and nerve root was compressed by disc hernia. C, Resected disc fragment in the second operation. D and E, Postoperative MRI showed decompressed spinal canal and foraminal area.

adhered disc (Fig. 1F and G). No signs of recurrence or other complications were detected before discharge.

2.2. The second operation

The patient reported pain in the right leg at 3 weeks after the first surgery. Conservative therapy was initiated using anti-inflammatory analgesics and central nervous system depressants, but the effect was poor after 1 week. Therefore, the patient was recalled to the hospital.

The patient reported that he had not rested in bed as instructed because of personal business, and the leg radicular pain had reappeared after 3 days of sitting to work. During this period, the patient had failed to wear the prescribed orthosis, and did not perform the back training. Physical examination revealed that the lower back pain was slightly worse, and the leg symptoms were similar but more serious compared with last time; the patient had to maintain a certain position to relieve the pain. The right toe back stretch strength was 3/5. MRI indicated an in situ recurrence, and confirmed the presence of a big mass of newly herniated disc that was compressing the dura, the right traveling root, and the foramen. The hyperintensity of the MC was greater than in the previous examination (Fig. 2). The VAS was 4 for lower back pain, and 8 for leg pain.

Emergency PELD was performed in the outpatient clinic. After administration of local anesthesia, a working cannula was inserted into the access built in the first surgery. Endoscopic vision exposed the massive herniated disc fragment, which was stuck inside the foramen along the traveling root, and included broken annulus fibrosus, large pieces of degenerated nucleus pulposus, and large fragments of endplate cartilage. The disc herniation close to the spinal canal was removed to prevent recurrence.

The leg pain was relieved after complete removal of the compression tissues, whose volume was approximately 5 mL. The traveling nerve root returned to its normal position after decompression, and the intraoperative straight leg rising test was negative. After 24 hours of observation, the leg symptoms had substantially improved, with the VAS decreased to 1; therefore, the patient was transferred to a local clinic for further postoperative care.

2.3. The third operation

The pain returned 1 month after the second operation, and the patient reported the same symptoms as before the revision. The patient was again recalled to the hospital.

Although bedrest was implemented, mild leg pain had been present since 14 days postoperatively, and had progressed to the same degree as preoperatively. Physical examination revealed almost the same findings as last time. MRI once again revealed recurrence at the same segment, and the volume of the compressive fragment was as large as last time (Fig. 3).

As this was the second recurrence of disc herniation, hypermobility was considered to be involved. Therefore,

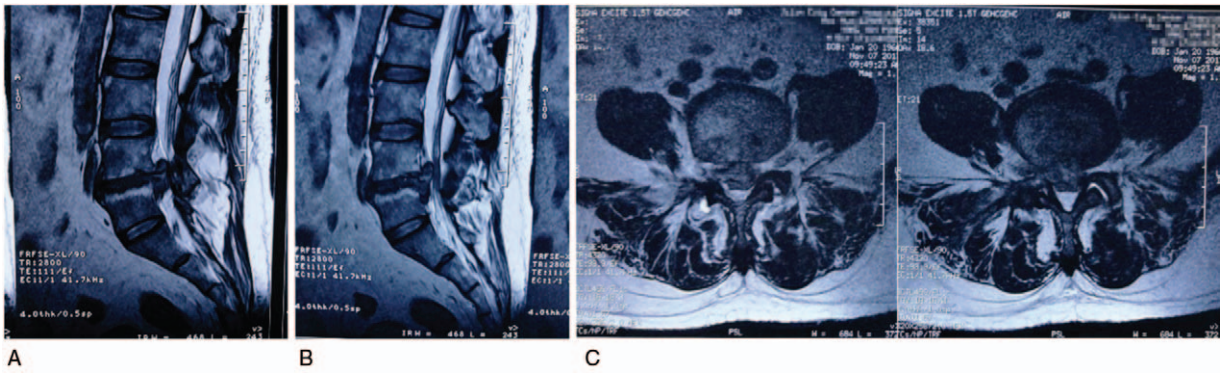

Figure 3. Preoperative MRI of the third discectomy with fusion. A–C, Recurrent LDH occurred once again on L4-L5, the disc hernia occupied the relevant spinal canal and compressed dura and nerve root. LDH = lumbar disc herniation, MRI = magnetic resonance imaging.

conventional posterior open discectomy with fusion under general anesthesia was performed. Pedicle screws and bone grafts were implanted to maintain spinal stability. A large volume of disc fragment was detected and removed during decompression, and no obvious compressive tissue was detected.

No signs of recurrence have developed in 6 months of follow-up, except for mild lower back pain during rapid changes in ambient temperature.

3. Discussion

Since the introductions of the Yeung endoscopic spine system (YESS) and transforaminal endoscopic spine system (TESSYS) discectomy procedures,[2,3] PELD has been increasingly performed over the last decade. Endoscopy has been applied widely in spine surgery, including for the treatment of cervical decompression, lumbar stenosis, far-migrated LDH, and lumbar burst fracture.[4,13] However, PELD is a nonfusion surgery, and so recurrence of disc herniation can occur. The present patient experienced LDH recurrence twice after PELD. The present case involved many factors that increased the risk of recurrence, including MC, high intravertebral space, lack of postoperative bedrest, instability induced by aggressive discectomy, and the revision plan.

3.1. Modic change and recurrent lumbar disc herniation

MC is strongly involved in lower back pain, and is highly prevalent in lumbar degenerative cases,[14] which are often combined with disc herniation. Various treatments for patients with LDH combined with MC at the same level have been discussed, but the outcomes remain controversial. Chin et al[15] reported significant improvement after nonfusion in minimally invasive discectomy, and suggested later fusion for younger patients, while Ohtori et al[16] suggested fusion surgery for patients with MC and hypermobility. Until now, few studies have reported surgical treatment for revision of LDH recurrence after PELD in patients with MC. The present patient had MC, which may induce lower back pain. Although PELD is minimally invasive, endplate cartilage damage is inevitable while performing prophylactic discectomy of the intervertebral disc (IVD) close to the spinal canal. Discectomy increases the incidence of MC,[17] as inflammatory cascades started from the degenerated IVD and damaged endplate are etiologic factors for MC.[14] The IVD complex is composed of the capping endplate and the surrounding annulus fibrosus and nucleus pulposus, which together build an enclosed structure with an internal core. As the core of the IVD, the nucleus pulposus cells are mainly nourished by nutrients secreted by the endplate, as few vessels grow through the cartilage and fiber tissue. Therefore, the fissured endplate and granulation tissue that typically occur in MC worsen the micro niche of the nucleus pulposus, leading to more severe disc degeneration, which results in a high incidence of LDH recurrence.[18]

In the present case, the presence of MC and the performance of aggressive discectomy in 2 PELD procedures may have led to disc collapse, which was identified by the presence of an abnormally large amount of resected disc fragment in the first and second revisions. MC is reportedly a risk factor for recurrent LDH after PELD,[19] as in the present case. The MRI before the second surgery revealed an advanced MC signal compared with the original MRI. As previously reported, MC might be caused by discectomy due to the osseous defects on the endplate;[20] hence, the worsened MC may have been induced by the PELD.

3.2. Disc height

Disc height preservation is strongly correlated with the recurrence of LDH. Yaman et al[18] reported that patients with LDH who had an increased preoperative disc height had a higher incidence of recurrence. The disc height in the present patient was 10.00 mm and preserved postoperatively, which indicated high recurrence rate due to no collapse at disc height. The MRI before the last surgery demonstrated that the disc height was still 9.80 mm, which explains the large volume of herniated disc fragments removed in the 3 surgeries (Figs. 1E and 2C).

Spinal canal occupancy of the herniated disc is also considered a predictor of recurrent LDH.[21] The present patient's spinal canal occupation was advanced when recurrent LDH occurred, suggesting a higher rate of relapse after the first revision. Camino Willhuber et al proposed that the disc occupancy should be measured on MRI T2-weighted axial slices; in the present patient, lateral slices were also important, especially regarding the direction and distance of migration of the newly herniated disc fragment.

3.3. Instability and bedrest

Compared with open discectomy with fusion, nonfusion surgeries have a higher rate of recurrence of 5% to 18%.[22]

One study reported that patients who underwent nonfusion minimally invasive discectomy had a recurrence rate of 16.9%,[21] while another reported that 19.8% of patients who had undergone discectomy had recurrent LDH.[18] In contrast, the reoperation rate after fusion discectomy is reportedly 10%, which includes revision for reasons other than recurrence.[23] This increased recurrence after nonfusion compared with fusion surgeries may be caused by postoperative instability or hypermobility.

It is well accepted that segments with MC are unstable,[24] and that MC is related to instability and lower back pain that can be improved by fusion surgeries.[16] This might be another reason why MC is considered a risk factor for recurrent LDH. The present patient's MC was worse after the first PELD, which further suggested lumbar instability. Furthermore, disc height is positively related to hypermobility and negative related to stiffness.[25] Our patient had an increased disc height and type 2 MC, which can induce lumbar hypermobility. However, prophylactic discectomy may not be appropriate in patients with LDH; in our experience, aggressive discectomy can induce instability, while slight discectomy leads to residual degenerated tissue, both of which may cause recurrence. During the foraminoplasty of PELD, the ventral part of the superior facet is drilled, which rarely leads to instability; however, in addition to the high disc and MC in the present patient, these factors were enough to cause instability when the patient ceased bedrest too soon. In our experience, most patients require 3 to 4 weeks of bedrest after PELD, and the prognosis is improved if the sitting position is avoided during bedrest.

3.4. Other factors

The present patient had a body mass index of 25.80, which is classified as overweight, and obesity (body mass index $\geq$ 25) is reportedly involved in recurrent LDH.[26] Smoking is also a well-known risk factor for disc degeneration, which is considered an independent risk factor for MC and lower back pain.[27] The present patient had been smoking for 20 years, which might have induced advanced MC and recurrent LDH.

3.5. Revision strategy

Patients who undergo nonfusion discectomy have a relatively higher recurrence rate than those who undergo fusion surgery. Although many clinicians report few relevant differences between primary and revision surgery,[5] 1 study reported that patients who underwent revisions felt less satisfied, even if they had significant clinical improvement.[28] Higher expectations and poorer outcome may reduce postoperative satisfaction; in China, revision of any surgery is gradually becoming a "must win" battle, which challenges the preoperative communication and surgery skills of clinicians.

As a minimally invasive surgery, PELD has advantages over open surgery regarding anesthetic risk, bleeding volume, and surgical trauma. Therefore, PELD is favored by clinicians for the revision of recurrent LDH after PELD and conventional open surgeries.[23] No minimally invasive method is currently recognized as being superior for revision after disc herniation recurrence;[29] however, as a revision surgery for endoscopic discectomy, PELD is minimally invasive, results in rapid recovery, and the access can be reused, which substantially shortens surgery time. PELD revision also has several disadvantages: without new access, residual fragment removal is as difficult as it was in the previous surgery, there is no radical improvement in stability, and the prophylactic discectomy is usually aggressive, which reduces lumbar stability. These factors should be carefully considered when deciding whether to revise a patient who has undergone PELD with a subsequent PELD. Discectomy of recurrent LDH might be more complex than for primary LDH, and many new problems must be solved using endoscopic visualization, such as the newly herniated disc, inflammatory tissues, and reactive proliferated scars; thus, discectomy of recurrent LDH should be handled by skilled surgeons.

In the present case, the surgical plan should be evaluated. In the first PELD surgery, far-migrated LDH was identified, and PELD was performed without controversy, as many clinicians agree that transforaminal PELD is able to remove a migrated disc of "very high" grade,[11] and several similar cases in our center were successfully treated with PELD. As MC was diagnosed, the present patient with lower back pain should have undergone flexion-extension radiographs to enable evaluation of spinal mobility. The most questionable surgical decision is the choice of PELD for the first revision surgery. The LDH recurrence appeared after quite a short time, and so many factors should have been considered; however, we only focused on the relief of the sciatica. The presence of MC increased disc height, and instability may have contributed to the recurrence of LDH. In the first revision, fusion surgery would have better improved the lumbar stability. Fusion surgery should reportedly be conducted when one of the following factors is present: instability, more severe back pain than leg pain, substantial MC, or additional stenosis;[30] the successful outcome after the second revision with fusion proved this point. Furthermore, we failed to remove some adhesion fragments during the first surgery; although few symptoms were caused by the residual herniated fragments, an approach other than broadening the original access should have been used to provide better intraoperative visualization.

3.6. The present case led to several recommendations in revision surgery for lumbar disc herniation

1. Patients with LDH recurrence may have lumbar instability, which requires fusion surgery. Lumbar mobility should be evaluated with caution.
2. MC and increased disc height are risk factors for recurrent LDH that should be considered during the surgical planning for patients with recurrent LDH after nonfusion surgery.
3. PELD is a good choice to revise PELD, and microdiscectomy is a good choice to revise microdiscectomy, but neither is good when the patient requires stabilization of the lumbar spine.
4. If residual disc fragments are identified on postoperative MRI, the same approach may not offer a better chance of fragment removal.
5. Patients who insist on PELD should be completely informed about the fusion surgery options.

4. Conclusions

No matter revising a recurrent LDH or treating primary LDH with PELD, adequate preoperative assessment of the lumbar region and even the whole spine should be carried out. PELD must be performed cautiously to decrease the incidences of recurrent LDH and revised PELD, and conventional open discectomy with fusion is able to take into account when necessary.

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