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Video Article

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Paramedian Unilateral 'Bitubular' Endoscopic Access for a Far Lateral Disc Herniation: A Novel Approach for Far Lateral Lumbar Pathologies

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We present a novel technique to approach far lateral lumbar pathologies using a bitubular, biportal endoscopic system and a paramedian approach. Background: Conventional approaches for lumbar far lateral discectomy range from open approaches to newer minimally invasive approaches such as tubular discectomy and single portal endoscopic discectomy. We present a case of a patient suffering with a left L3–4 and left L4–5 extraforaminal disc herniation who was treated successfully with a left sided bitubular, biportal endoscopic 2 level far lateral discectomy. A paramedian 'bitubular' biportal endoscopic approach is safe and effective for far lateral lumbar pathologies with excellent visualisation due to good outflow of irrigation fluid.

Keywords: Lumbar, Endoscopy, Intervertebral disc, Discectomy

INTRODUCTION

Far lateral disc herniations make up about 10% of lumbar disc herniations and include foraminal and extraforaminal disc herniations.[1] Traditional approaches to treating this condition include an open approach which can either be interlaminar or paramedian[2,3] with newer published techniques using minimally invasive approaches. These include tubular and single portal endoscopic approaches.[4,5] Although a biportal approach has been described previously for far lateral discectomy and extraforaminal conditions,[6-8] no articles to our knowledge have been published on the use of 2 clear plastic tubes with a biportal approach for endoscopic far lateral discectomy. The technique for using 2 clear plastic, single use, disposable tubes[9] helps to aid fluid inflow and outflow which in turn provides an excellent clear field for visualisation.

CASE REPORT

The patient was a 67-year-old male who presented with a 10-day history of sudden onset of back pain and left leg pain radiating to the buttock and posterior thigh. The pain was causing limitation in his walking and his self-described visual analogue scale (VAS) score for back pain was 8/10. His self-described VAS score for leg pain was 8/10. He had a positive straight leg raise test at 50°.

Clinical examination revealed an antalgic gait with reduction in fine touch sensation in the left L4 dermatome, all other dermatomes revealed normal sensation and his motor power was Medical Research Council 5/5 in all lower limb myotomes. The patient had no past medical history of note, and his only medications were oral analgesics.

The T2-weighted images of his magnetic resonance imaging (MRI) scan of his lumbar spine on 13/08/2024 showed evidence of a capacious canal and a left L3–4 and a left L4–5 extraforaminal disc herniation (Figs. 1–3). There was also evidence of bilateral L5–S1 pars defects, but flexion extension views did not reveal any dynamic instability (Figs. 4 and 5).

After a consultation regarding the options of conservative

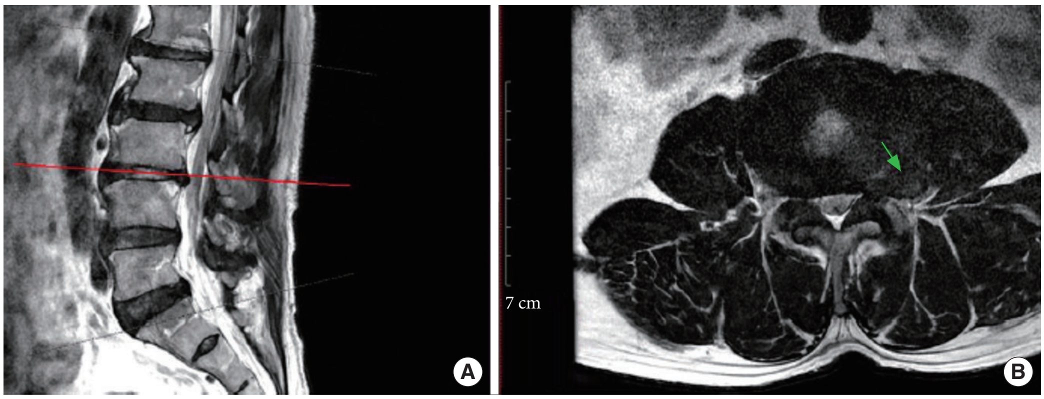

Fig. 1. A T2-weighted preoperative magnetic resonance imaging sagittal (A) and axial (B) slice showing the left L3–4 extraforaminal disc herniation (green arrow).

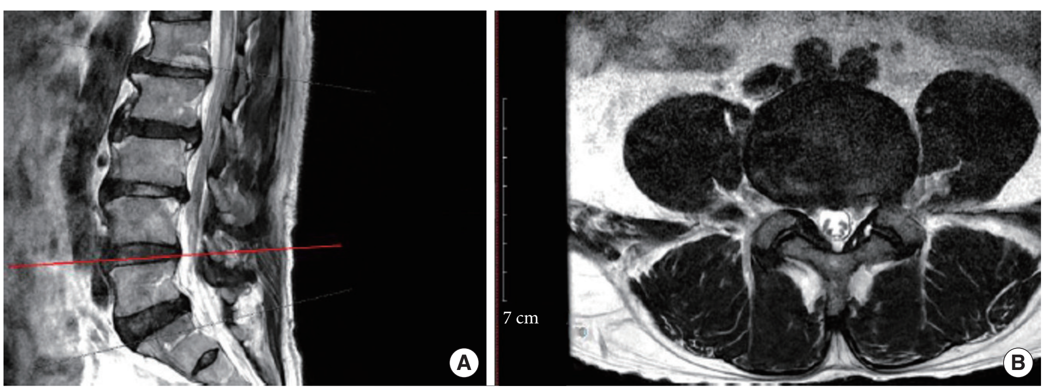

Fig. 2. A T2-weighted preoperative magnetic resonance imaging sagittal (A) and axial (B) slice showing the left L4–5 foraminal disc herniation.

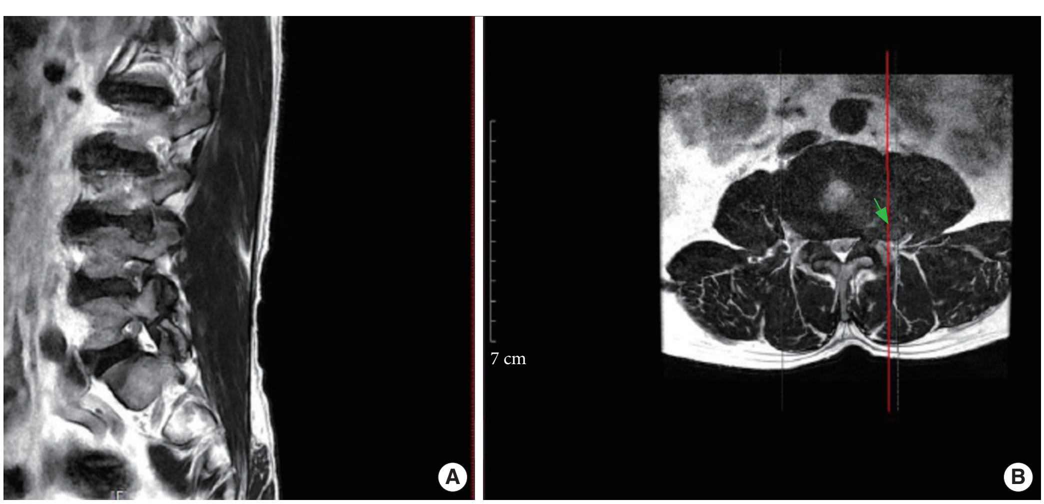

Fig. 3. A T2-weighted preoperative magnetic resonance imaging sagittal (A) and axial (B) slice showing the left L3–4 (green arrow) and left L4–5 foraminal stenosis due to the disc herniations.

Fig. 4. A preoperative standing lateral radiograph of the patient in extension.

Fig. 5. A preoperative standing lateral radiograph of the patient in flexion.

management versus surgical management with the senior author, the patient elected to have surgical management in the form of a biportal endoscopic far lateral discectomy via the paramedian approach which was conducted by the senior surgeon.

Written informed consent was obtained from the patient.

1. Surgical Approach

The patient was given epidural anaesthesia with sedation and placed prone on a Jackson table with a Wilson frame. Preoperative intravenous antibiotics were given (cefazedone 1 g). A standard preparation of the skin with an iodine based surgical cleaning solution was performed and then surgical drapes were applied.

The skin was marked using C arm fluoroscopy for the left L3, L4, and L5 pedicles, using a spinal needle and methylene blue is injected at these points for easy recognition during endoscopy.

The skin is also marked for the incisions which are 1-cm transverse incisions lateral to the midpoint of the pedicles and are over the transverse process (TPs). The caudal incision is made first for the working portal (WP). Fat and fascia are incised in line with the incisions. Blunt dissection using the proximal end of a scalpel handle is performed on the distal TP, which is followed medially until the lateral aspect of the superior articulating process (SAP) is encountered. Further blunt dissection through the WP is performed along the lateral margin of the facet joint, in a cranial direction towards the junction of the cranial TP and the inferior articulating process (IAP). The cranial incision is made second for the endoscopic portal (EP). Blunt dissection is performed in a similar fashion through the EP along the cranial TP towards the pars and the facet joint.

Switching rods are placed through the portals and triangulation is performed using these, with the triangulation site being at the pars interarticularis. Serial dilators are placed over the switching rods, followed by clear plastic tubular ports (6–8 mm) in diameter. These ports are single use, disposable instruments. The tube for the EP is 6.2 mm in diameter and the tube for the WP is 8.2 mm in diameter. The differential diameter allows for excellent fluid through flow within the working space and excellent outflow.

2. Soft Tissue Debridement Stage

The 4-mm endoscope is introduced into the EP and decompression of the far lateral area is performed with instruments placed through the WP. Soft tissue debridement is performed using a radiofrequency (RF) ablator of the facet capsule over the SAP. Starting at the facet capsule and identifying the underlying bone of the SAP, is the easiest way for the surgeon to become orientated at this initial stage.

Debridement is then turned to the cranial part of the intertransverse space, and the caudal edge of the cranial TP is identified and debrided up to the TP-IAP junction. Anterior to the muscular tissue, the surgeon can then identify the ligamentum flavum (LF) which will be a continuous sheet from the cranial TP to the IAP and then to the SAP to the caudal TP.

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3. Bone Drilling Stage

The lateral part of the SAP is burred away. The author's preference is to use a 3.7-mm oval drill with a fluted surface and a shield. The shield is useful to help the surgeon avoid inadvertent burring towards the LF and the nerve. The extent of the drilling of the SAP is until the underlying attachment of the LF can be seen. Thereafter it can be carefully peeled away from the SAP using a curette.

The caudal edge of the cranial TP can also be drilled away, focusing on its junction with the IAP to reveal the superolateral attachment of the LF in the interspace. For this part, the author's preference is to use a 3.7-mm oval drill with a diamond surface, set in a counterclockwise direction.

4. Detatchment of the LF

The LF can be carefully taken off the superolateral corner by using a 2-mm Kerrison punch. Care should be taken to avoid damaging the exiting nerve root which will be revealed once the LF is taken off. Within this area is a complex of small blood vessels and bleeding can be conspicuous. We would recommend prompt ablation using RF of any bleeding vessels to keep the endoscopic view clear.

The rest of the LF can then be removed from the intertransverse space in a cranial to caudal direction.

5. Removal of Herniated Far Lateral Disc

Once the exiting nerve root has been exposed, it can be carefully mobilised in a cranial direction. A herniated far lateral disc fragment can be explored for in the axilla of the nerve. The nerve can be held away from the disc by using the EP clear plastic port as a retractor. A 2-mm Kerrisons punch is used to make an annulotomy, and to remove loose disc fragments.

Once the disc herniation has been cleared, the exiting nerve will be freely mobile. We recommend cauterization of any blood vessels over the disc and annuloplasty, using RF, to help shrink any remaining disc bulge.

6. Checking the Exit Foramina of the Nerve

Checking the exit foramina for the nerve is the next stage. This is reserved for only after the disc removal as prior to the disc removal the nerve is not easily mobile.

The foramina can be exposed with some further burring in the cranial medial corner of the intertransverse space, i.e., at the junction between the cranial TP and the IAP. Any bony overhang can also be removed using a 2-mm Kerrisons punch. Adhesions along the pathway of the nerve can be checked for using a nerve hook and any residual disc fragment can be searched for in the axilla of the nerve towards the foramen. In the video, a residual foraminal disc fragment is found and carefully teased out of the foramen in a single piece.

The surgical bed is checked for bleeding and haemostasis is performed using RF.

If the surgeon wishes to look further medially towards the foramen, the authors recommend changing to a 30° endoscope to visualise this area better.

A final palpation of the area using a nerve hook will reveal any minor obstructing lesions such as residual small fragments of LF or disc that can be removed easily with a 2-mm Kerrisons punch or pituitary forceps.

7. Tips to Avoid Over Drilling of the Pars Whilst Negotiating the TP of the Cranial Vertebra

The exiting nerve root can always be located at the caudal margin of the cranial TP. Once the nerve root is found, it can be traced medially with bony decompression until its junction with the pars is revealed. At this point, no further drilling medially is required, which minimizes damage to the pars.

Alternatively, the exiting nerve root can be found after removing the tip of the SAP and the LF. Once it is visualised, no further drilling medially is required which also minimizes damage to the pars.

8. Rationale for Chosen Technique

In our centre, the senior surgeon is an experienced endoscopic spine specialist who has over a decade of experience doing biportal endoscopic spine surgery. In his hands, this technique gives an excellent view of the surgical target with reproducible results and a low complication rate. His preference is to use 2 clear plastic tubular ports with a differential inner diameter, to create the biportal system which gives excellent inflow and outflow of irrigation fluid.

DISCUSSION

In this video we demonstrate a case of a left L3–4 and left L4–5 far lateral decompression and discectomy via a bitubular, biportal endoscopic approach. To show the technique, only decompression of one level is shown in the video, to save time. Endoscopic discectomy is a well-established technique for the treatment of lumbar disc herniations.[4,5,10] There can be a steep learning curve and there is a risk of complications such as incomplete removal, recurrence, nerve root injury, dural tear, nerve root induced hyperalgesia, epidural haematoma, and bleeding.[10,11]

Biportal lumbar endoscopic spine surgery is an increasingly popular technique for treatment of common lumbar conditions. The use of 2 portals is efficacious and has been shown to have a low complication rate, faster learning curves and good outcomes.[12] These favourable outcomes have also been shown in larger studies involving more than 3,000 patients.[13]

Articles for technical tips describe anatomical considerations[14] but these can be hard for the learner surgeon to visualise. Our video is a useful addition to the current expanse of literature to help the learner surgeon navigate this potentially technically challenging procedure.

The other options for the treatment of far lateral disc herniations has expanded from a traditional open approach, which can utilize either a central incision, or a paramedian incision,[3,15,16] to more minimally invasive approach where the options exist of tubular assisted,[17,18] or endoscopic assisted approaches.[19-21] Biportal endoscopy is a popular approach as it has a shorter learning curve, is relatively simpler to adopt, with a more familiar approach, and is well-suited for interbody fusion.[5,10,22]

It has been described as an approach for far lateral, foraminal and extraforaminal pathologies.[6-8]

There are also other published descriptions of different types of endoscopic approaches for discectomy.

Endoscopic lumbar discectomy can be performed through an interlaminar as well as a transforminal approach. It is recognised that far lateral and foraminal disc herniations are difficult to approach through the interlaminar window[23] and there are more studies on endoscopic far lateral discectomy that use the transforaminal approach.[14,20,21,24]

There are few studies that compare different minimally invasive and endoscopic techniques for lumbar far lateral discectomy.

Sebben et al.[4] compared 31 patients undergoing a uniportal translaminar technique for central and lateral disc herniations to 24 patients undergoing a uniportal transforaminal technique for foraminal and far lateral disc herniations. It was found that the transforaminal approach had a slightly higher rate of postoperative parasthesia due to stimulation of the dorsal root ganglion from insertion of the instruments, but both approaches had a low incidence of complications and low rates of recurrence.

Lin et al.[25] compared 12 patients treated with a lateral SAP approach to 20 patients treated with a transforaminal approach for far lateral disc herniations recording similar outcomes in both groups. The group treated with the lateral SAP approach had significantly shorter hospital stays and operative times compared to the transforaminal group. However, both groups had small numbers of patients and this study was comparing a variation of a uniportal endoscopic technique.

Kong et al.[24] compared 26 patients who underwent a paraspinal muscle splitting open trans tubular discectomy to 30 patients who underwent a single portal endoscopic discectomy for far lateral disc herniations and showed similar outcomes in both groups. There were significantly longer operating times, more radiation exposure but shorter hospital stays in the endoscopic group compared to the tubular group. This study also had small numbers in each group.

Some studies describe unilateral endoscopy techniques for far lateral disc herniation but are generally small case series. Musharbash and Lee[20] describe a single portal, posterolateral, intertransverse approach in 22 patients with far lateral disc herniations, but still had a 9.1% rate of post operative dysesthesia, which is a recognised common complication in uniportal disecectomy, due to irritation of the dorsal root ganglion from the singular portal. Greil et al.[19] describe a single portal, trans pars articularis approach for far lateral disc herniations in a case series of 14 patients. However, this approach requires invasion of the pars articularis, which can be avoided in biportal endoscopic spine surgery. Wang et al.[26] describes portal positions in unilateral biportal endoscopy for various lumbar pathologies, including far lateral disc herniation, but does not describe the procedure beyond recommendations for portal position. Park et al.[6] described their technique for unilateral biportal endoscopy for a far lateral discectomy, but there is no accompanying video with their description. Kashlan et al.[21] published a video article on a uniportal transforaminal endoscopic approach for a far lateral discectomy, however to our knowledge, there are no published video articles on biportal endoscopic far lateral discectomy.

In this video of biportal endoscopic far lateral discectomy, we describe a step-by-step method on how to perform this procedure. This includes positioning and set up, skin marking and incisions, soft tissue dissection to facilitate the EPs, then the bone drilling, releasing the LF, exposure of the exiting nerve, removal of the herniated disc and finally checking of the foramina. By following this method, we feel that learner surgeons can achieve safe and reliable results for far lateral discectomy by the biportal endoscopic approach.

Furthermore, our technique is the only described method, to our knowledge, that utilizes 2 tubular clear plastic ports with differential inner diameters, which the authors recommend for these following advantages. The ports provide excellent inflow and outflow. Firstly, this keeps the surgical field clear of blood and debris, enabling the surgeon to see well to perform the pro-

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cedure. Secondly, the good outflow reduces the risks of tissue swelling or inadvertent fluid collection in the retroperitoneum and other areas in the abdomen. This increases the safety for the patient. Thirdly, as the ports are made of clear plastic, they have an added function as soft tissue retractors when required. When used as retractors, the dura and nerve roots can be visualised and safely protected, which gives the surgeon confidence during drilling, dissecting and ablating.

Some of the challenges that were encountered during the procedure included epidural bleeding from a leash of vessels around the nerve root. This can occur when the LF is removed from around it. This is dealt with promptly by use of RF ablation to the epidural vessels.

Following the procedure the patient made a full recovery with no postoperative complications. His left leg radiculopathy improved and he experienced no recurrence of symptoms. His postoperative MRI scan images showed adequate decompression of the left exiting nerve roots and foraminae at L3–4 and L4–5 (Figs. 6–9).

In conclusion, although various methods for far lateral discectomy have been described, no article to our knowledge describes using 2 clear plastic ports and a biportal endoscopic approach for this condition. We present the first video article of biportal endoscopic far lateral discectomy, with step-by-step instructions on how to perform this procedure from start to finish, with utilization of 2 clear plastic tubular ports which allow good inflow and outflow of irrigation fluid, giving a clear endoscopic view to the surgeon. We believe this method has many advantages over the traditional open and single portal endoscopic approach which would benefit patients and surgeons alike.

Fig. 6. A T2-weighted postoperative magnetic resonance imaging sagittal (A) and axial (B) slice showing adequate discectomy of the left L3–4 far lateral disc.

Fig. 7. A T2-weighted postoperative magnetic resonance imaging sagittal (A) and axial (B) slice showing adequate decompression of the left L4–5 far lateral region.

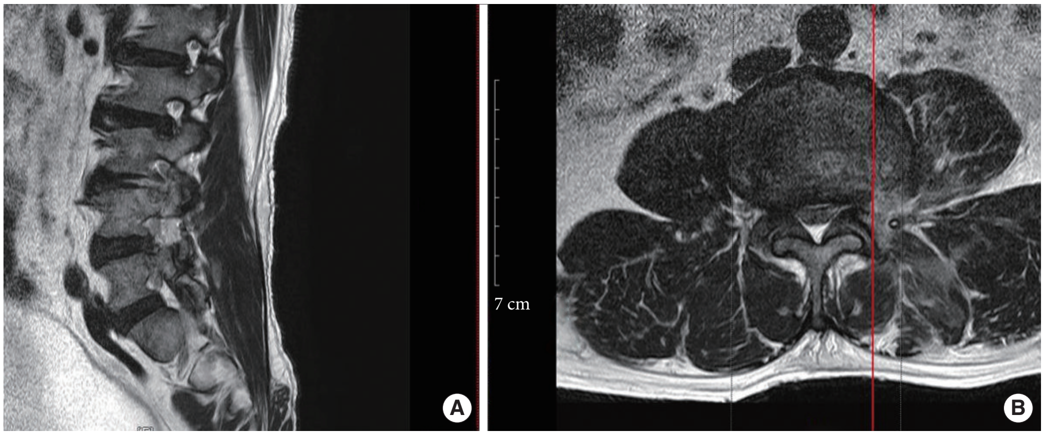

Fig. 8. A T2-weighted postoperative magnetic resonance imaging sagittal (A) and axial (B) slice showing an adequate foraminal decompression of the left L3–4 foramina.

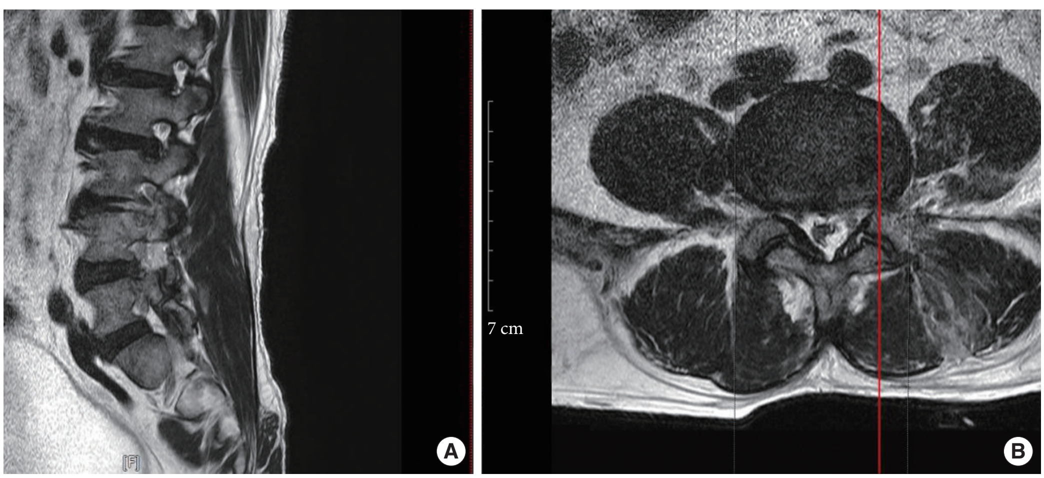

Fig. 9. A T2-weighted postoperative magnetic resonance imaging sagittal (A) and axial (B) slice showing an adequate foraminal decompression of the left L4–5 foramina.

NOTES

Video File: The video file for this article is available at https://doi.org/10.14245/ns.2449096.548.

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REFERENCES

1. Berra LV, Di Rita A, Longhitano F, et al. Far lateral lumbar disc herniation part 1: imaging, neurophysiology and clinical features. World J Orthop 2021;12:961-9.
2. Abdullah AF, Ditto EW 3rd, Byrd EB, et al. Extreme-lateral lumbar disc herniations. Clinical syndrome and special problems of diagnosis. J Neurosurg 1974;41:229-34.
3. Al-Khawaja DO, Mahasneh T, Li JC. Surgical treatment of far lateral lumbar disc herniation: a safe and simple approach. J Spine Surg 2016;2:21-4.
4. Sebben AL, Kulcheski AL, Graells XSI, et al. Comparison of

two endoscopic spine surgical techniques. Rev Assoc Med Bras (1992) 2021;67:243-7.
5. Jitpakdee K, Liu Y, Heo DH, et al. Minimally invasive endoscopy in spine surgery: where are we now? Eur Spine J 2023; 32:2755-68.
6. Park JH, Jung JT, Lee SJ. How I do it: L5/S1 foraminal stenosis and far-lateral lumbar disc herniation with unilateral biportal endoscopy. Acta Neurochir (Wien) 2018;160:1899-903.
7. Park MK, Son SK, Park WW, et al. Unilateral biportal endoscopy for decompression of extraforaminal stenosis at the lumbosacral junction: surgical techniques and clinical outcomes. Neurospine 2021;18:871-9.
8. Heo DH, Sharma S, Park CK. Endoscopic treatment of extraforaminal entrapment of L5 nerve root (far out syndrome) by unilateral biportal endoscopic approach: technical report and preliminary clinical results. Neurospine 2019;16:130-7.
9. Medirover.com [Internet]. Hanam: Medirover; [cited 2024 Nov 10]. Available from: https://medirover.com/?module=Board&action=SiteBoard&sMode=VIEW_FORM&iBrdNo=1&iBrdContNo=6&sBrdContRe=0&sSearchField=&sSearchValue=&CurrentPage=1.
10. Balain B, Bhachu DS, Gadkari A, et al. 2nd and 3rd generation full endoscopic lumbar spine surgery: clinical safety and learning curve. Eur Spine J 2023;32:2796-804.
11. Zhou C, Zhang G, Panchal RR, et al. Unique complications of percutaneous endoscopic lumbar discectomy and percutaneous endoscopic interlaminar discectomy. Pain Physician 2018;21:E105-12.
12. Perez EG, Santander XA, Llinas Amengual P, et al. Biportal endoscopic spine surgery: clinical results for 163 patients. World Neurosurg 2023;180:e676-85.
13. Park DY, Upfill-Brown A, Curtin N, et al. Clinical outcomes and complications after biportal endoscopic spine surgery: a comprehensive systematic review and meta-analysis of 3673 cases. Eur Spine J 2023;32:2637-46.
14. Ahn Y. Transforaminal percutaneous endoscopic lumbar discectomy: technical tips to prevent complications. Expert Rev Med Devices 2012;9:361-6.
15. Khan JM, McKinney D, Basques BA, et al. Clinical presentation and outcomes of patients with a lumbar far lateral herniated nucleus pulposus as compared to those with a central or paracentral herniation. Global Spine J 2019;9:480-6.
16. Albayrak S, Atci IB. A retrospective study of far lateral midline microlumbar discectomy in 20 patients at a single center in Turkey. Med Sci Monit 2023;29:e941257.
17. Siu TL, Lin K. Microscopic tubular discectomy for far lateral lumbar disc herniation. J Clin Neurosci 2016;33:129-33.
18. Laskay NM, Jarrell MT, Salehani A, et al. Minimally invasive far lateral lumbar discectomy with modified technique: symptomatic relief and intersegmental stability study. Cureus 2024; 16:e53415.
19. Greil ME, Ogunlade JI, Bergquist J, et al. Full-endoscopic trans-pars interarticularis approach for far lateral lumbar discectomy. Eur Spine J 2023;32:2709-16.
20. Musharbash FN, Lee SH. A modified endoscopic access for lumbar foraminal pathologies; posterolateral "intertransverse" endoscopic approach to minimize postoperative dysesthesia following transforaminal approach. Neurospine 2023;20:150-7.
21. Kashlan ON, Kim HS, Khalsa SSS, et al. Percutaneous endoscopic transforaminal approach for far lateral lumbar discectomy: 2-dimensional operative video. Oper Neurosurg (Hagerstown) 2020;18:E8.
22. Gunjotikar S, Pestonji M, Tanaka M, et al. Evolution, current trends, and latest advances of endoscopic spine surgery. J Clin Med 2024;13:3208.
23. Fukuhara D, Ono K, Kenji T, et al. A narrative review of full-endoscopic lumbar discectomy using interlaminar approach. World Neurosurg 2022;168:324-32.
24. Kong L, Huang Y, Yao T, et al. Retrospective analysis of paraspinal muscle-splitting microscopic-assisted discectomy versus percutaneous endoscopic lumbar discectomy for the treatment of far-lateral lumbar disc herniation. Turk Neurosurg 2023;33:541-7.
25. Lin L, Ke ZY, Chu L, et al. Full-endoscopic lumbar discectomy via lateral superior articular process approach for treating far lateral lumbar disc herniation: a retrospective study and technical note. Int Orthop 2023;47:2843-50.
26. Wang Y, Maimaiti A, Tuoheti A, et al. The method of portal making in lumbar unilateral biportal endoscopic surgery with different operative approaches according to the constant anatomical landmarks of the lumbar spine: a review of the literature. Global Spine J 2024;14:1838-61.