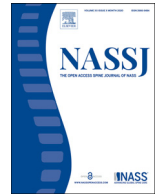




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## Clinical Case Studies

## Intradural disc herniation of L2/3: A case report and literature review

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## ARTICLE INFO

## Keywords:

Intradural herniation  
Lumbar disc disease  
Diagnostic imaging  
Open discectomy  
Interbody fusion  
Durotomy

## ABSTRACT

**Background:** Intradural herniation (IDH) or transdural disc herniation is a rare presentation of lumbar disc disease. Preoperative imaging findings should be carefully and thoroughly interpreted. Although imaging modalities such as computed tomography (CT) or magnetic resonance imaging (MRI) are readily available, a definitive diagnosis cannot be made based solely on these modalities. Operative procedures must be planned to prevent unexpected complications.

**Case description:** A 67-year-old man presented with right lower extremity weakness and numbness with bowel and bladder involvement for 2 weeks, after falling from a standing position. MRI revealed a large herniated disc at L2-L3, which was suspected to be IDH. Posterior discectomy and interbody fusion were also performed. Intraoperative findings revealed no disc material in the epidural space or dural sac tenting. Dorsal midline durotomy was performed, and a mass-like lesion was found and resected. Subsequently, pathological analysis revealed disc tissue with evidence of moderate chronic inflammation and a focal increase in fibrosis. The patient was discharged without complications.

**Results (Outcome):** Lower extremity strength improved to grades IV-V, accompanied by a return to normal bowel and bladder function within 1 month, without any wound complications. Lower extremity strength recovered fully to grade V, and the patient started walking independently within 6 months.

**Conclusions:** A large disc herniation, suspected to be an IDH, should be thoroughly investigated by carefully reviewing MRI scans before proceeding with any surgical procedure to prevent unexpected situations. Nonetheless, preoperative imaging alone does not ensure a definitive diagnosis, and the differential diagnosis must include other mass-like lesions. Intraoperative findings and pathological reports are essential for definitive diagnosis of IDH.

## Background

Intradural herniation (IDH) or transdural disc herniation is a rare presentation of lumbar disc disease that presents with symptoms indistinguishable from those of usual lumbar disc herniation. Careful examination during preoperative diagnostic imaging can help in a possible or tentative diagnosis. Preoperative diagnosis is crucial for the selection of surgical techniques. Nonetheless, discriminating IDH from the usual large disc herniation in order to make a definitive diagnosis is difficult. Spinal tumors and intradural cysts must also be considered in the differential diagnosis. Pathological examination can be used as a confirmatory method for definitive diagnosis of IDH.

## Case description

A 67-year-old man presented with right lower extremity weakness and numbness with bowel and bladder involvement for 2 weeks, after falling from a standing position. The patient was unable to ambulate and required a wheelchair for mobility. He denied experiencing back pain. The patient had no history of spinal surgery. Physical examination revealed decreased strength of the right lower extremity. Additionally, the muscle test results were (as V): knee extension, grade III; ankle dorsiflexion, grade II; toe extension, grade II; and ankle plantar flexion, grade III. A sensation test showed a decreased pinprick sensation in the

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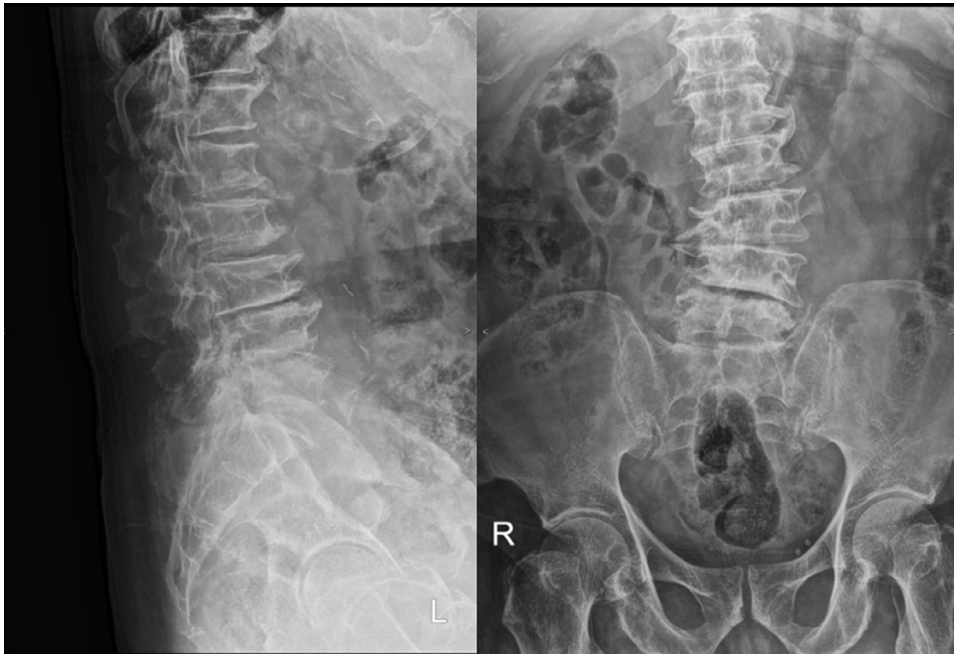
E-mail addresses: [vit.k@chula.ac.th](mailto:vit.k@chula.ac.th), [vitinspine@gmail.com](mailto:vitinspine@gmail.com) (V. Kotheeranurak).

<https://doi.org/10.1016/j.xnsj.2022.100138>

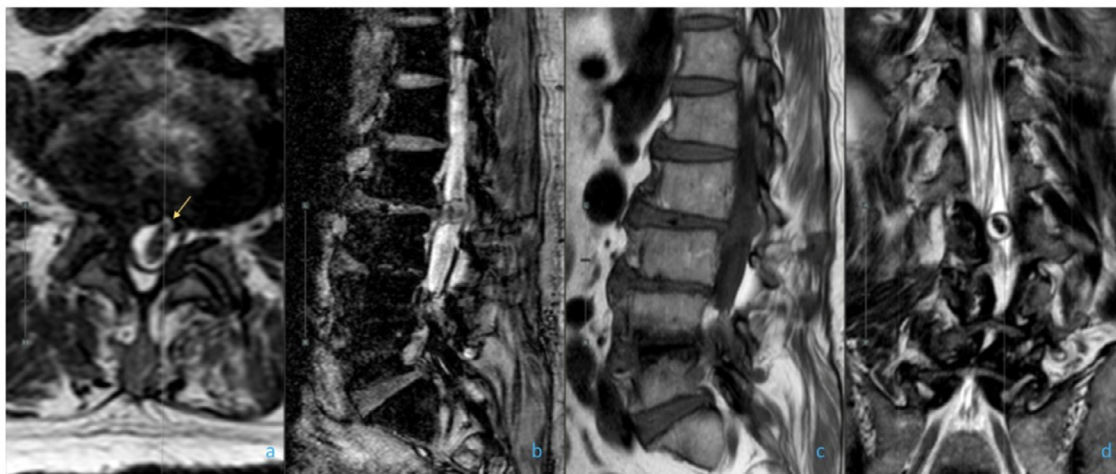
Received 29 March 2022; Received in revised form 13 June 2022; Accepted 13 June 2022

Available online 18 June 2022

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**Fig. 1.** Lumbosacral spine radiography AP and lateral views showing lumbar spondylosis, straightening alignment with scoliosis, grade I retrolisthesis at L3 over L4, no significant anterior vertebral height loss, and multiple levels of decreased intervertebral disc height. No bridging ossification of the anterior longitudinal ligament (ALL) and no ossification of the posterior longitudinal ligament (OPLL) are seen. AP, anterior/posterior.



**Fig. 2.** Axial T2-weighted (a) sagittal GRE T2\*-weighted; (b) sagittal T1-weighted; (c) coronal T2-weighted; (d) MR images show an intradural CSF-filled sac-like lesion containing an elliptical-shaped T2-hypointense material at left-sided L2/3 spinal level, with spraying and compression on the cauda equina that is contiguous with the anterolateral defected annulus, posterior longitudinal ligament, and dural sac [arrow in (a)]. The differential diagnosis was intradural mass, such as an intradural tumor or lumbar disc herniation. GRE, gradient recalled echo; MR, magnetic resonance.

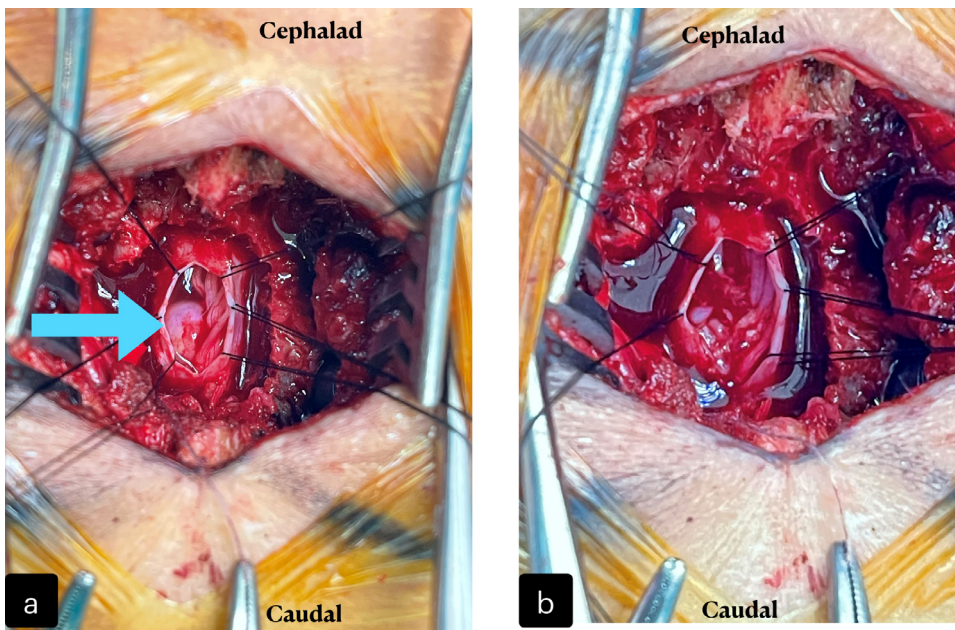
right L3-S1 dermatome. Subsequently, a rectal examination showed fair sphincter tone and decreased perianal sensation.

Plain radiography showed straightening alignment with scoliosis and multiple levels of decreased intervertebral disc height (Fig. 1). Magnetic resonance imaging (MRI) revealed intradural sequestered disc herniation at the L2/3 level, which appeared to cause compression of the right L3 traversing nerve root (Fig. 2a-d).

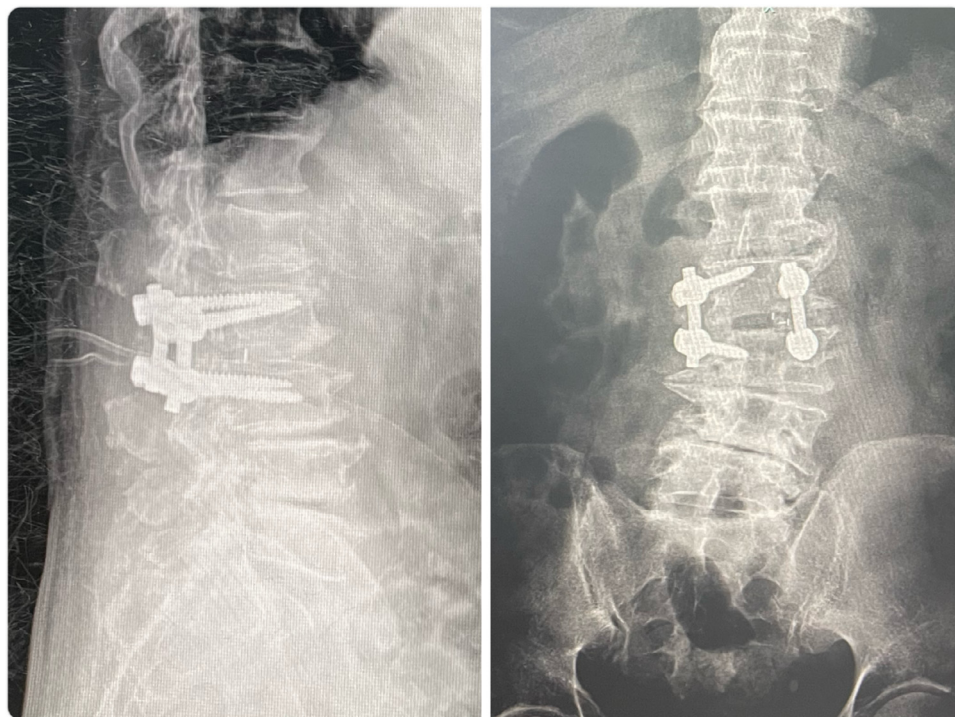
The preoperative diagnosis was IDH at L2/3 with neurological deficits. The operative method was decided on the basis of muscle weakness. Extensive laminectomy and durotomy were required; therefore, we decided to perform an interbody fusion procedure to prevent recurrent herniation and late spinal instability.

After a laminectomy at L2 was completed, followed by a flavectomy, intraoperative findings revealed tenting of the dural sac at the L2/3 level, and no disc material was found in the epidural space. Intradural inspection was performed using surgical loupes. After meticulously

opening the dural sac and separating the nerve rootlets, a round, smooth, mass-like lesion (approximately 2.5 × 2.5 cm) was discovered within the dural sac, surrounded by nerve rootlets (Fig. 3a). We attempted dissection of the lesion to maintain its containment, but failed due to its connection and strong adherence to the ventral dura, at the dorsal L2-3 intervertebral disc. We removed as much content as possible until the rootlets were free and the ventral dura adhered to the dorsal intervertebral disc (Fig. 3b). Fine exploration of the mass revealed disc-like material in the lesion, and the mass was sent for pathological examination. Tight closure of the dural sac was performed. Next, the Valsalva maneuver was performed to check for cerebrospinal fluid (CSF) leakage. Finally, instrumented transforaminal lumbar interbody fusion was completed at the L2/3 level, followed by wound closure and drain placement (Fig. 4). Pathological reports showed disc tissue with moderate chronic inflammation and focal increased fibrosis (Fig. 5a-c). The procedure performed in this study was in accordance with the ethical standards of the



**Fig. 3.** Intraoperative findings  
a) Space-occupying mass: round, smooth, approximately 2.5 × 2.5 cm, surrounded by nerve rootlets (blue arrow).  
b) Dural sac after intradural mass removal.



**Fig. 4.** Postoperative lumbar spine radiograph showing interbody fusion with posterior instrumentation.

institutional and national research committee, and the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. This study was approved by the institutional ethics committee (EC) (EC number 16/2021).

### Outcomes

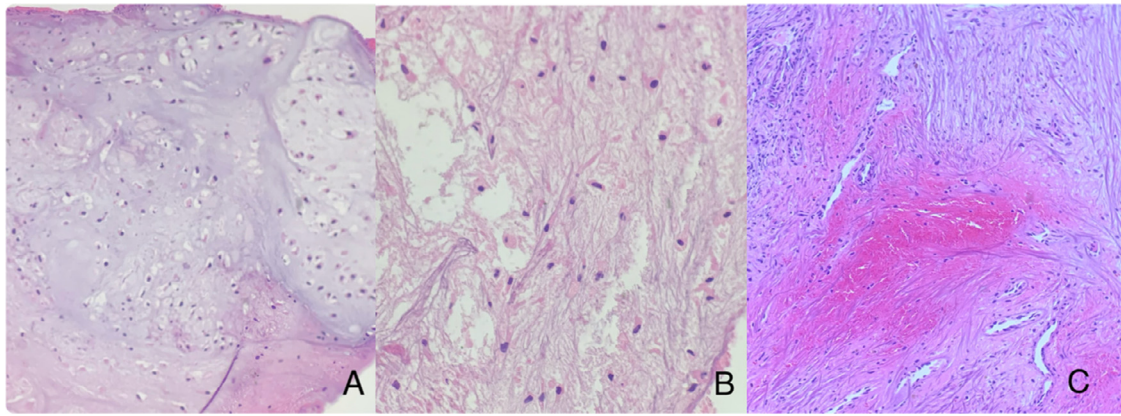
At the 1-month postoperative follow-up, the patient's strength had improved from grade II-III to IV-V. His uncontrolled bowel and bladder function returned to normal levels. The patient could walk using a walker, and no wound complications were noted.

At the 6-month postoperative follow-up, the patient's strength in the right lower extremity fully recovered to grade V, and he was able to

ambulate independently without an assistive device. The pinprick sensation in the right leg was normal.

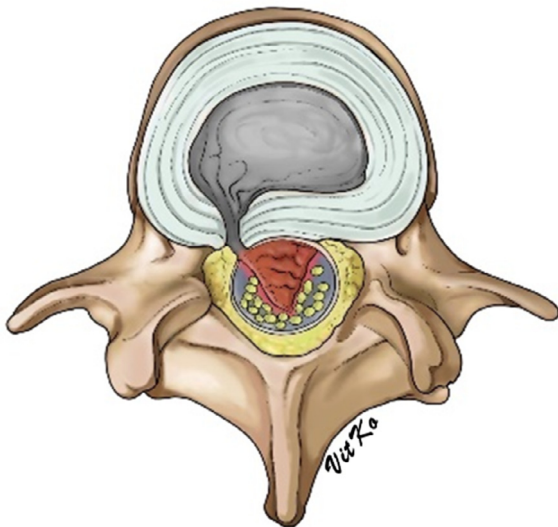
### Methods

A literature search was performed to identify articles published in PubMed using the following MeSH terms: disc and herniation and intradural and lumbar. The PubMed search engine was used to identify published articles available in full text. In total, 205 articles were identified. Studies involving the pathogenesis, diagnostic methods of IDH, imaging studies, differential diagnosis, and surgical techniques were considered eligible and reviewed. Only articles written in English were included in the review.



**Fig. 5.** Histologic examination

- a) Fragments of cartilage consisting of chondrocytes located in lacunae within the background of chondroid matrix, consistent with nucleus pulposus.  
 b) Fragments of cartilage with myxoid degeneration, indicating disc degeneration.  
 c) Pieces of fibrocollagenous tissue with vascular ingrowth and focal hemorrhage, consistent with annular fibrosus with focal degeneration.



**Fig. 6.** Hawk-beak sign; relative sharp or beak-like appearance of a herniated disc.

## Discussion

Intradural disc herniation (IDH) or transdural disc herniation in the lumbar spine is a rare condition, indistinguishable from the usual lumbar disc herniation presentation. The incidence of IDH in the lumbar region is approximately 0.26–0.3% of all lumbar disc herniations. Of these, 92% were found in the lumbar region, mostly at the L4/5 level (55%) (L3/L4 [16%], L5/S1 [10%]) and are rarely seen at the L1/L2 and L2/L3 levels [1–4]. The peak incidence of IDH occurs in the fifth to sixth decades of life and is four times more common in men than in women [5]. The etiology of this condition remains unclear. Nonetheless, some theories describe chronic inflammation and adhesions due to degenerative disc disease, leading to erosion of the dura, after which disc materials migrate into the dural site. Another theory is that chronic compression leads to a thinner dura mater. Compression may be caused by congenital stenosis, congenital reduction in dura thickness, or iatrogenic causes after an operative procedure [1, 6, 7].

IDH is often initially misdiagnosed as other more common conditions [8]. Preoperative misdiagnosis prolongs the operative time and leads to difficulty in making intraoperative decisions [9]. Notably,

plain radiography and computed tomography (CT) may not reveal an IDH. Kobahashi et al. reported that sequestered IDH might appear as air at the herniated site on CT images [10]. Contrast-enhanced MRI is the gold standard of neuroimaging. Nonetheless, some authors suggest that a definitive diagnosis is made intraoperatively because it is difficult to accurately diagnose IDH from preoperative MRI alone; IDH can be confused with usual large disc herniation or mimic a spinal tumor [11]. In addition, differentiating an IDH from other spinal lesions, including arachnoid cysts, spinal metastases, and abscesses, can be difficult based only on MRI findings [5]. Nam et al. reviewed 32 MRI studies of surgically confirmed IDHs. They reported that IDH can be predicted using MRI with imaging signs of ill-defined margins (PPV=97.51%, NPV=15.18%), beak-like shape (PPV=98.73%, NPV=18.8%), discontinuity of PLL (PPV=98.34%, NPV=25.28%), Y-sign on the ventral dura (PPV=99.02%, NPV=15.82%), disc material beyond the PLL (PPV=98.53, NPV=15.85%), and calcification or ossification of the disc material (PPV=97.68%, NPV=11.86%). The highest specific sign is the abrupt discontinuity of the posterior longitudinal ligament (PLL), as found in our case [12]. Gadolinium-enhanced MRI is useful to differentiate IDH from spinal tumors, infections, or other lesions [12] (Table 1). The herniated discs reveal homogeneously isointense lesions on T1- and T2-weighted MRI or a beak-like mass with ring enhancement caused by chronic granulation tissue and peripheral neovascularization at the intervertebral disc level [12]. In T2-weighted images, IDH can be revealed by posterior longitudinal ligament (PLL) discontinuity, a “Y” sign, which is caused by splitting of the ventral dura line. It can also be revealed as a voluminous disc without signs of CSF surrounding the disc, poor disc margin, or increased signal intensity surrounding the herniation, which is caused by an inflammatory reaction [13, 14].

Surgical treatment requires total laminectomy with durotomy to remove intradural disc material, followed by dural closure to prevent CSF leakage. Pedaballe et al. suggested that the primary repair of the ventral dura may be necessary [9]. Some authors placed hemostatic material at the ventral dural surface to occlude the possibility of dural leakage [7]. Serikyaku et al. reported 16 cases of ventral durotomy without repair, none of which showed postoperative CSF leakage [15]. Additionally, chronic inflammation leads to dural fragility. Therefore, avoiding unnecessary retraction of the dural sac is crucial. A surgical microscope or loupe can provide clearer vision to minimize the risk of rootlet injury and enable adequate decompression. Posterior interbody fusion and fixation are recommended for preventing recurrent disc herniation [10]. Postoperative outcomes were related to preoperative symptoms, symptom duration, and herniation level.

**Table 1**  
Differential diagnosis of intradural disc herniation from MRI features.

MRI characteristics Disease	T1W	T2W	Peripheral ring enhancement	PLL discontinuity
Intradural disc herniation	Lowsignal	Lowsignal	Y	Y
Intradural tumor	Vary	Vary	Y/N	N
Abscess	Lowsignal	Highsignal	Y	N
Arachnoid cyst	Lowsignal	Highsignal	Y	N

T1W=T1-weighted MRI; T2W=T2-weighted MRI; PLL=posterior longitudinal ligament; Y=Yes; N=No.

To the best of our knowledge, L2/3 is uncommon for IDH, making our case of an already rare condition even more noteworthy. The MRI findings in our case, which led us to suspect IDH, revealed discontinuity of the PLL and an intradural CSF-filled sac-like lesion containing T2-hypointense material with a three-layer contiguous defect including the annulus, PLL, and dural sac. In our opinion, this group of findings provides the strongest evidence for IDH based on MRI findings. Nonetheless, MRI with contrast is suggested preoperatively to prevent misdiagnosis or unplanned surgery if the MRI evidence is vague or if prior MRI cannot distinguish IDH from other spinal lesions.

### Conclusion

IDH is a rare condition that is most common in the lumbar region. A definitive diagnosis using preoperative MRI, alone, is challenging. Evidence of a large disc herniation on MRI does not enable clinicians to differentiate IDH from disc extrusion or reach a definitive diagnosis of IDH. A neurological radiologist consultation may be required before the operative procedure for a well-planned surgery. Posterior laminectomy with durotomy and intradural fragment removal remains the mainstay surgical treatment.

### Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

### Acknowledgments

The authors would like to acknowledge Dr. Wattana Sukauychai (Department of Neurosurgery, Rayong Hospital) for the dedication in being on the surgical team.

### Summary sentence

A rare case of intradural disc herniation at L2/3 level in a 67-year-old man with definitive diagnosis based on preoperative and intraoperative findings.

### Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author upon reasonable request.

### References

- [1] Ge CY, et al. Intradural Lumbar Disc Herniation: A Case Report and Literature Review. *Clin Interv Aging* 2019;14:2295–9.
- [2] Rathod T, et al. Intradural Disc Herniation in the Lumbar Spine: a Case Report. *JNMA J Nepal Med Assoc* 2020;58(225):345–8.
- [3] Sharma A, et al. Intradural Disc a Diagnostic Dilemma: case Series and Review of Literature. *Asian J Neurosurg* 2018;13(4):1033–6.
- [4] Yu Y, et al. Unexpected intradural disc herniation instead of space-occupying tumor at L3-L4 level: a case report and literature review. *Am J Transl Res* 2021;13(9):10891–5.
- [5] Luo D, et al. Intradural disc herniation at L4/5 level causing Cauda equina syndrome: a case report. *Medicine (Baltimore)* 2020;99(7):e19025.
- [6] Ashraf A, Babar ZU. Intradural Disc Herniation: a Case Report and Literature Review. *Cureus* 2020;12(4):e7600.
- [7] Ducati LG, et al. Intradural lumbar disc herniation: report of five cases with literature review. *Eur Spine J* 2013;22(Suppl 3):S404–8.
- [8] Thohar Arifin M, et al. Challenges in intradural disc herniation diagnosis and surgery: a case report. *Ann Med Surg (Lond)* 2020;58:156–9.
- [9] Pedaballe AR, et al. An Unusual Case of Transdural Herniation of a Lumbar Intervertebral Disc: diagnostic and Surgical Challenges. *World Neurosurg* 2019;128:385–9.
- [10] Kobayashi K, et al. Intradural disc herniation: radiographic findings and surgical results with a literature review. *Clin Neurol Neurosurg* 2014;125:47–51.
- [11] Kim HS, et al. Transforaminal Endoscopic Excision of Intradural Lumbar Disk Herniation and Dural Repair. *World Neurosurg* 2018;119:163–7.
- [12] Liu CC, et al. Intradural disc herniation at L5 level mimicking an intradural spinal tumor. *Eur Spine J* 2011;20(Suppl 2):S326–9.
- [13] Nam KH, et al. Imaging characteristics of intradural disc herniation: a comparison with large disc extrusion. *Eur J Radiol* 2021;137:109569.
- [14] Holtás S, et al. MR imaging of intradural disk herniation. *J Comput Assist Tomogr* 1987;11(2):353–6.
- [15] Serikyaku H, Higa S, Yara T. Intradural disc herniation at the L1-2 level. *Surg Neurol Int* 2021;12:351.