

Delineating the Intradural Space: A Comparative Series of Spinal Cord Lesions

Imam Hidayat*¹, Mohanad Alhasani², Muhammad Hagi², Azzam Faiz Mutawakkil¹

¹Department of Neurosurgery, Faculty of Medicine, Universitas Syiah Kuala/Dr. Zainal Abidin Hospital, Banda Aceh, Indonesia

²Departement of Plastic Reconstructive and Aesthetic Surgery, Faculty of Medicine, Universitas Syiah Kuala/Dr. Zainal Abidin Hospital, Banda Aceh, Indonesia

ABSTRACT

Background: Intradural spinal tumors are uncommon neoplasms that exhibit heterogeneous clinical manifestations and radiological features. They are classified as intradural extramedullary [IDEM] and intramedullary spinal cord tumors [IMSCT], both of which may cause progressive neurological deficits. Accurate neurological assessment, radiological evaluation, and histopathological confirmation are essential for diagnosis and surgical planning.

Methods: We retrospectively reviewed three consecutive patients with intradural spinal tumors treated at Dr. Zainal Abidin General Hospital, Banda Aceh, Indonesia, between November 2025 and January 2026. Clinical data, preoperative MRI findings, surgical techniques, histopathological results, and postoperative neurological outcomes were analyzed. Neurological status was assessed using the Medical Research Council [MRC] scale and Frankel grade.

Results: Two patients presented with IDEM lesions at the thoracic T6–T7 and lumbosacral L3–L4 levels, confirmed as metastatic carcinoma and meningothelial meningioma, respectively. One patient had a long-segment cervical IMSCT extending from C1 to C5, histopathologically diagnosed as psammomatous meningioma. All patients underwent posterior laminectomy with microsurgical tumor excision. Despite radiological decompression, persistent postoperative neurological deficits were observed during short-term follow-up.

Conclusion: This case series highlights substantial clinical and radiological variability in intradural spinal tumors. Acute neurological deterioration may occur in small IDEM lesions, while extensive IMSCT involvement may paradoxically present with preserved motor function. Early diagnosis and individualized surgical management remain critical to optimize neurological outcomes. Further studies with long-term follow-up and molecular analysis are warranted.

KEYWORDS: intradural spinal neoplasms; intradural extramedullary tumor; intramedullary spinal cord tumor; meningioma; spinal cord compression; case series.

ARTICLE DETAILS

Published On:
16 July 2026

Available on:
<https://ijmscrs.com>

I. INTRODUCTION

Spinal cord tumors are anatomically classified as extradural and intradural lesions. Intradural tumors arise within the dural sac and account for approximately 15% of all central nervous system [CNS] neoplasms^{1,2}. Intradural spinal tumors are further subdivided into IDEM tumors, which

originate outside the spinal cord parenchyma, and IMSCT, which arise within the spinal cord itself^{1,3}.

IDEM tumors, predominantly schwannomas and meningiomas, represent the majority of intradural spinal neoplasms^{4,5}. In contrast, IMSCT are rare, comprising 2–4% of all CNS tumors and 20–30% of spinal cord tumors^{3,6}. Both IDEM and IMSCT may cause significant neurological

Delineating the Intradural Space: A Comparative Series of Spinal Cord Lesions

morbidity through spinal cord compression or parenchymal infiltration^{5,7}. Clinical manifestations are often insidious and may include axial pain, radiculopathy, sensory disturbances, motor weakness, gait impairment, and autonomic dysfunction^{5,7,8}. Delayed diagnosis contributes to irreversible neurological deficits and poorer postoperative outcomes^{8,10}.

Although the epidemiology and surgical management of intradural spinal tumors have been described^{9,10}, reports emphasizing clinicoradiological heterogeneity within limited case series remain scarce. Acute neurological deterioration may occur even in histologically benign IDEM tumors, while extensive intramedullary involvement may present with relatively preserved neurological function^{7,10}. These variations influence surgical timing, operative strategy, and neurological prognosis^{5,11}.

This study aims to describe the clinical manifestations, radiological findings, surgical management, and histopathological characteristics of three patients with intradural spinal tumors, with emphasis on the diverse clinical and radiological presentations of IDEM versus IMSCT lesions.

II. METHODS

A. Study Design and Setting

This retrospective case series was conducted at the Department of Neurosurgery, Dr. Zainoel Abidin General Hospital, Banda Aceh, Indonesia, in collaboration with the Department of Plastic Reconstructive and Aesthetic Surgery, Universitas Syiah Kuala. The study period was from November 2025 to January 2026.

B. Participants

Three consecutive patients aged ≥ 18 years with intradural spinal tumors confirmed by preoperative contrast-enhanced MRI and postoperative histopathology were included. Patients with incomplete medical records or without histopathological confirmation were excluded.

C. Data Collection

Clinical data including age, sex, symptom duration, neurological examination using MRC muscle strength scale and Frankel grade, sensory and autonomic function, MRI characteristics, surgical details, histopathological diagnosis, and postoperative outcomes were extracted from medical records. Follow-up was performed at 10 days to 6 weeks postoperatively.

D. Surgical Procedure

All patients underwent posterior laminectomy or hemilaminectomy with microsurgical tumor excision. Intraoperative neuromonitoring was utilized when available. Dural closure was performed primarily with 5-0 non-absorbable suture.

E. Outcome Measures

Primary outcome was change in neurological status assessed by MRC scale and Frankel grade. Secondary

outcomes included radiological decompression and histopathological diagnosis.

F. Statistical Analysis

Descriptive statistics were used. Continuous variables are presented as median and range; categorical variables as frequency and percentage.

G. Ethical Approval

This study complied with CARE Guidelines. IRB approval was not required for this retrospective case series by the Ethics Committee of Dr. Zainoel Abidin Hospital/Universitas Syiah Kuala. Written informed consent for publication of clinical data and images was obtained from all patients.

III. CASE SERIES

A. Case 1

A 50-year-old male presented with progressive bilateral lower extremity weakness for two months, with rapid deterioration three days prior to admission. He reported stabbing low back pain radiating to both feet, numbness below the T8–T9 dermatome, and urinary retention for five days. Neurological examination revealed normal upper extremity strength [MRC grade 5/5] and severely reduced lower extremity strength [MRC grade 1/5 bilaterally]. He was classified as Frankel grade A.



Figure 1. MRI T2-weighted sequence demonstrating an intradural extramedullary mass at the T6–T7 level measuring $1.25 \times 1.13 \times 1.41$ cm.

Contrast-enhanced thoracic MRI demonstrated an oval-to-lobulated IDEM lesion at T6–T7 measuring $1.25 \times 1.13 \times 1.41$ cm, isointense on T1-weighted images, hypointense on T2-weighted images, hyperintense on TIRM sequences, with marked contrast enhancement and severe spinal cord compression [Figure 1]. The patient underwent thoracic laminectomy and tumor excision. Histopathology confirmed metastatic carcinoma. At follow-up, paraparesis, hypoesthesia below T8–T9, urinary incontinence, and low back pain persisted without substantial improvement.

B. Case 2

A 29-year-old male presented with two-month history of progressive bilateral lower extremity weakness and low back pain radiating to both legs. Motor strength was MRC grade

Delineating the Intradural Space: A Comparative Series of Spinal Cord Lesions

5/5 in upper extremities and MRC grade 1/5 in lower extremities. Sensory and autonomic functions were preserved.

Lumbosacral MRI revealed an oval IDEM mass measuring 1.45 x 0.96 x 3.84 cm within the cauda equina at L3–L4 with spinal canal stenosis and bilateral facet joint effusion from L3–S1 [Figure 2]. The patient underwent laminectomy, tumor excision, and posterior spinal stabilization. Histopathology confirmed meningotheelial meningioma. Postoperative evaluation showed persistent paraparesis without significant neurological improvement.

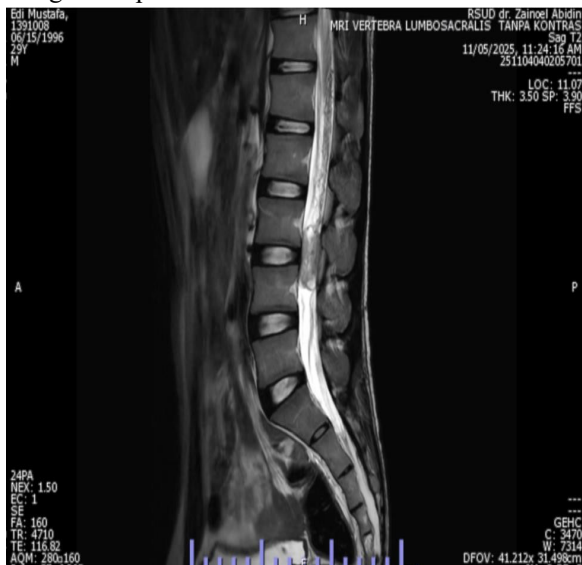


Figure 2. MRI T2-weighted sequence showing an intradural extramedullary spinal tumor extending from the L3–L4 level within the cauda equina region.

C. Case 3

A 42-year-old female presented with one-year history of progressive weakness in all four extremities and reduced walking endurance, accompanied by neck numbness and urinary incontinence. Motor strength was preserved [MRC grade 5/5], but sensory examination revealed hypoesthesia below T8–T9.



Figure 3. MRI T2-weighted sequence demonstrating an IMSCT extending from C1 to C5 with heterogeneous signal intensity.

Cervical MRI demonstrated a long-segment IMSCT extending from C1 to C5 with fusiform configuration, ill-defined margins, heterogeneous signal intensity, hypointense on T1-weighted and hyperintense on T2-weighted images [Figure 3]. Cervical laminectomy and tumor excision were performed [Figure 4]. Histopathology confirmed psammomatous meningioma. Postoperatively, subjective weakness persisted without significant deterioration or improvement.

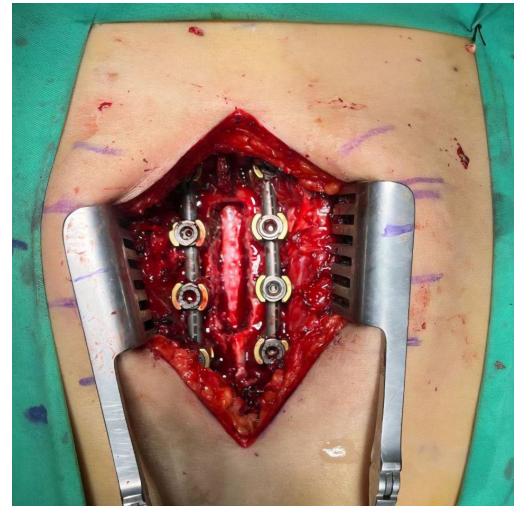


Figure 4. Clinical photograph showing the surgical site after posterior cervical laminectomy and tumor excision.

IV. DISCUSSION

This case series demonstrates the clinical, radiological, and histopathological heterogeneity of intradural spinal tumors. Two IDEM lesions and one IMSCT showed variable neurological presentations despite differences in anatomical location and tumor biology.

IDEM tumors typically cause neurological deficits through progressive spinal cord compression rather than direct infiltration^{8,12}. Although meningiomas and schwannomas are usually slow-growing with chronic symptoms^{4,5}, acute deterioration may occur due to rapid compromise of spinal cord perfusion or severe canal occupancy^{7,1}. In Case 1, a relatively small T6–T7 lesion caused severe paraplegia and urinary retention, highlighting that neurological severity does not always correlate with tumor size^{5,8}.

IMSCT are biologically distinct due to infiltrative growth within spinal cord parenchyma^{3,6}, often resulting in progressive neurological decline and greater surgical complexity. However, Case 3 demonstrated a long-segment cervical IMSCT extending from C1 to C5 with relatively preserved motor function, consistent with previous reports of clinico-radiological mismatch in IMSCT^{7,1}.

MRI remains the primary imaging modality for diagnosis and surgical planning^{8,16}. In this series, MRI successfully identified all lesions. However, discrepancy

Delineating the Intradural Space: A Comparative Series of Spinal Cord Lesions

between MRI interpretation and definitive histopathology in Case 3 underscores the diagnostic limitations of imaging alone^{18,19}. Histopathological examination remains essential for definitive diagnosis^{5,15}.

Postoperative neurological recovery is influenced by symptom duration, preoperative deficit severity, tumor location, and extent of spinal cord involvement^{5,17}. All patients in this series had persistent deficits, likely due to prolonged cord compression and delayed presentation^{8,10}. Thoracic and intramedullary lesions are associated with less favorable outcomes due to limited functional reserve and surgical complexity^{5,14}.

CONCLUSIONS

Intradural spinal tumors exhibit considerable clinical and radiological heterogeneity. Acute neurological deterioration may occur in small IDEM lesions, while extensive IMSCT involvement may present with relatively preserved motor function. These findings underscore the importance of comprehensive neurological evaluation, accurate radiological assessment, and histopathological confirmation. Early recognition and individualized surgical planning are essential to optimize neurological outcomes. Future studies should incorporate molecular analysis and long-term follow-up.

REFERENCES

- I. Ottenhausen M, Ntoulas G, Bodhinayake I, Ruppert FH, Schreiber S, Förschler A, et al. Intradural spinal tumors in adults-update on management and outcome. *Neurosurg Rev*. 2019 Jun;42(2):371–88. Available from: <https://doi.org/10.1007/s10143-018-0957-x>
- II. Setiawati DA, Setyono H. Intradural extramedullary spinal cord tumors and outcome with surgical approach: a single centre retrospective study. *Biosci Med*. 2022;6(15):2491–6. Available from: <https://doi.org/10.37275/bsm.v6i15.693>
- III. Rijs K, Klimek M, Scheltens-de Boer M, Biesheuvel K, Harhangi BS. Intraoperative Neuromonitoring in Patients with Intramedullary Spinal Cord Tumor: A Systematic Review, Meta-Analysis, and Case Series. *World Neurosurg*. 2019 May;125:498-510.e2. Available from: <https://doi.org/10.1016/j.wneu.2019.01.007>
- IV. Budiman Gondowardojo YR, Ompusunggu SE, Dahlan RH. Diagnosis and Management of Intradural Extramedullary Tumor: Multiple Case Series and Literature Review. *Neurol Spinal Med Chir*. 2022;5(2):63–71. Available from: https://doi.org/10.4103/nsmc.nsmc_4_22
- V. Menon G, Srinivasan S, Nair R, Hegde A, Nair S. Spinal Intramedullary Tumors. *Arch Med Heal Sci*. 2022;10(2):238–45. Available from: https://doi.org/10.4103/amhs.amhs_263_22
- VI. Ostrom QT, Patil N, Cioffi G, Waite K, Kruchko C, Barnholtz-Sloan JS. CBTRUS Statistical Report: Primary Brain and Other Central Nervous System Tumors Diagnosed in the United States in 2013-2017. *Neuro Oncol*. 2020 Oct;22(12 Suppl 2):iv1–96. Available from: <https://doi.org/10.1093/neuonc/noaa200>
- VII. Neyazi B, Haghighi A, Mawrin C, Hattingen E, Vordermark D, Sandalcioğlu IE. Spinal Intramedullary Tumors. *Dtsch Arztebl Int*. 2024 Jun;121(25):840–6. Available from: <https://doi.org/10.3238/arztebl.m2024.0213>
- VIII. Samartzis D, Gillis CC, Shih P, O'Toole JE, Fessler RG. Intramedullary Spinal Cord Tumors: Part I-Epidemiology, Pathophysiology, and Diagnosis. *Glob Spine J*. 2015 Oct;5(5):425–35. Available from: <https://doi.org/10.1055/s-0035-1549029>
- IX. Phankongsab A, Sopchokchai I, Pimomchai P. Epidemiology study on the prognostic factors of intradural extramedullary spinal tumors. *J Craniovertebral Junction Spine*. 2024;15(3):361–6. Available from: https://doi.org/10.4103/jcvjs.jcvjs_53_24
- X. Hadar AK, Mns B, Ramdhan A, Rahim AH, Siwendro BA, Setiadi C. Large primary Intradural extramedullary spinal tumors: A case report. *Int J Surg Case Rep*. 2023 Oct;111:108825. Available from: <https://doi.org/10.1016/j.ijscr.2023.108825>
- XI. Goodarzi A, Clouse J, Capizzano T, Kim KD, Panchal R. The Optimal Surgical Approach to Intradural Spinal Tumors: Laminectomy or Hemilaminectomy? *Cureus*. 2020 Feb;12(2):e7084. Available from: <https://doi.org/10.7759/cureus.7084>
- XII. Arnautovic K, Arnautovic A. Extramedullary intradural spinal tumors: a review of modern diagnostic and treatment options and a report of a series. *Bosn J Basic Med Sci*. 2009 Oct;9 Suppl 1(Suppl 1):S40–5. Available from: <https://doi.org/10.17305/bjbms.2009.2755>
- XIII. Iyer RR, Jallo GI. Intramedullary spinal cord tumors. In: *Brain Spine Surg Elder*. Springer; 2017. p. 277–88. Available from: https://doi.org/10.1007/978-3-319-40232-1_16
- XIV. Kotecha R, Mehta MP, Chang EL, Brown PD, Suh JH, Lo SS, et al. Updates in the management of intradural spinal cord tumors: A radiation oncology focus. *Neuro Oncol*. 2019 Jun;21(6):707–18. Available from: <https://doi.org/10.1093/neuonc/noz014>
- XV. Patel P, Mehendiratta D, Bhambhu V, Dalvie S.

Delineating the Intradural Space: A Comparative Series of Spinal Cord Lesions

- Clinical outcome of intradural extramedullary spinal cord tumors: A single-center retrospective analytical study. *Surg Neurol Int.* 2021;12:241. Available from: https://doi.org/10.25259/SNI_839_2020
- XVI. Mechtler LL, Nandigam K. Spinal cord tumors: new views and future directions. *Neurol Clin.* 2013 Feb;31(1):241–68. Available from: <https://doi.org/10.1016/j.ncl.2012.09.011>
- XVII. McGirt MJ, Chaichana KL, Atiba A, Attenello F, Yao KC, Jallo GI. Resection of intramedullary spinal cord tumors in children: Assessment of long-term motor and sensory deficits. *J Neurosurg Pediatr.* 2008 Jan;1(1):63–7. Available from: <https://doi.org/10.3171/PED-08/01/063>
- XVIII. Faraj CA, Snyder RI, Tatsui CE, McCutcheon IE. Neurosurgical emergencies in spinal tumors: pathophysiology and clinical management. *Emerg Cancer Care.* 2024;3(1):2. Available from: <https://doi.org/10.1186/s44201-024-00024-5>
- XIX. Dieringer L, Baumgart L, Schwierer L, Gempt J, Wostrack M, Meyer B, et al. Spinal Intradural Tumor Resection via Long-Segment Approaches and Clinical Long-Term Follow-Up. *Cancers.* 2024;16(10):1782. Available from: <https://doi.org/10.3390/cancers16091782>