



Pseudomeningocele with Nerve Root Incarceration after Lumbar Spine Surgery: A Case Report and Review of Literature

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A 44-year-old female patient suffered from low-pressure headaches 18 days after lumbar spine surgery for a herniated lumbar intervertebral disc. A loss of sphincter control was also observed. On physical examination, a fluctuating swollen wound was observed, where clear fluid was aspirated. A neurological examination revealed perineal pain and numbness. Pseudomeningocele with nerve root incarceration was suspected. Open laminectomy was performed to examine the previous surgical site. After identification and extirpation of the pseudomeningocele, the incarcerated nerve roots were replaced by the dural defect. Direct dural repair was performed using a microsurgical technique. The patient was discharged with headache resolution and improved perineal pain and numbness at the outpatient clinic follow-up.

Key words: pseudomeningocele, nerve root incarceration, incidental durotomy, low-pressure headaches, lumbar spine surgery

Introduction

Incidental durotomies are an inherent risk in lumbar spinal surgery and may lead to the formation of pseudomeningoceles. This case report describes the patient's clinical course from initial spinal surgery to recovery after dural defect repair.

Case Report

A 44-year-old female retired schoolteacher denied any underlying medical diseases.

However, she had chronic low back pain for four years. The pain is most significant when standing or sitting for prolonged periods and is associated with radiating pain along the left lateral thigh to the dorsum of the foot. As a result, she experienced intermittent claudication, which limited her walking distance. Although her pain improved with rest, the patient attempted rehabilitative treatment and nerve block; however, these treatments did not relieve her discomfort.

The patient presented to the orthopedic clinic for evaluation of progressive pain, and a neurological examination revealed that her left

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foot dorsiflexion was significantly weaker than that of her right foot. In addition, radiographic studies confirmed L5 neuroforamen encroachment by a herniated L5 – S1 intervertebral disc. Therefore, the patient underwent bilateral L5 – S1 laminotomy by an orthopedic surgeon to decompress the L5 nerve root.

Eighteen days postoperatively, the patient experienced excruciating headaches and sought help from a neurologist. These symptoms were associated with severe nausea and vomiting. The headaches were exacerbated in the upright position and relieved in the recumbent position, suggesting low-pressure headaches. Physical examination revealed a fluctuating swollen wound where clear fluid was aspirated. Neurological examination revealed significant perineal pain and numbness, which developed after lumbar surgery. The patient developed voiding difficulties and stool incontinence.

An electrodiagnostic study was performed to determine the cause of perineal pain and numbness, voiding difficulties, and stool incontinence. Although the results were within normal limits, the patient's recent surgical history, low-pressure headache, and focal neurological symptoms warranted magnetic

resonance imaging of the lumbar spine. Subcutaneous and subfascial fluid collections (Fig. 1A) were observed in the lumbar region. In addition, T2 hyperintensities were noted anterior to the lumbar thecal sac and extended along the right L5 neuroforamen (Fig. 1B), suggesting a pseudomeningocele. Consequently, the patient was referred to the neurosurgery service, and surgery was proposed for direct visualization and repair.

Informed consent was obtained, and the patient underwent an exploration of the previous surgical site. The remaining L5 spinous process and lamina were removed intraoperatively. The hypertrophic ligamentum flavum was excised. An operating microscope was used to examine the pseudomeningocele, which revealed arachnoid membrane containing incarcerated nerve roots herniated from the thecal sac (Fig. 2A). Cerebrospinal fluid (CSF) leakage was observed at the base of the dural tear.

Granulation tissue adherent to the arachnoid membrane was dissected and removed. A longitudinal dural incision was made both proximal and distal to the base of the pseudomeningocele to open the dural ring around

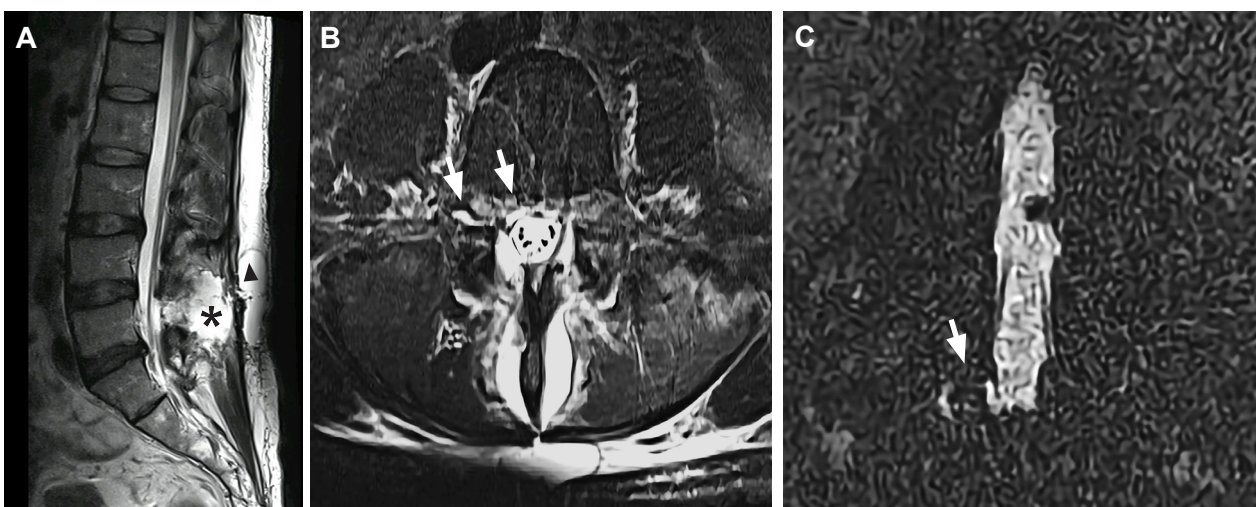


Fig. 1 (A) Sagittal T2 magnetic resonance imaging (MRI) of the lumbar spine. Subcutaneous (triangle) and subfascial (asterisk) fluid collection were observed in the lumbar region. (B) Axial T2 MRI at the L5 level. T2 Hyperintensities were noted anterior to the thecal sac and along the right L5 neuroforamen, suggestive of a pseudomeningocele. (C) Corresponding coronal magnetic resonance myelography at the L5 level. Nerve root incarceration may be inferred from the loss of T2 signal where T2 hyperintensity extends along the right L5 neuroforamen.

the incarcerated nerve root. The arachnoid membrane was also extended to release the CSF and allow the incarcerated nerve roots to become free of pressure (Fig. 2B) and be replaced through the dural defect into the thecal sac (Fig. 2C). Watertight closure of the dural opening was performed by using 6 – 0 Prolene sutures. The dural surface was covered using Duragen Plus.

Postoperatively, the patient resumed activities of daily living and reported resolution of headache upon discharge. In addition, the patient reported resolution of voiding difficulties and fecal incontinence at the initial outpatient follow-up. However, the patient noted residual perineal pain and numbness, which improved over subsequent visits.

Discussion

Incidental durotomies are not rare complications of lumbar spine surgeries, even when performed by experts. Unfortunately, the incidence is likely to be underreported owing to spinal surgeons' reluctance to publish their complications. Pseudomeningoceles may form because of incidental durotomies. The reported incidence ranges from 0.07% to 2%.¹ Pseudomeningoceles may be diagnosed within the perioperative period or as late as ten years post-operation.²

Multivariate analysis for risk factors of incidental durotomy during spinal surgery identified revision spine surgery, laminectomy, older age,³ and operative duration ≥ 250 minutes⁴ as independent risk factors. Fusion, foraminectomy, and a lateral surgical approach were identified as independent protective factors.³

A fluctuant swollen wound at the previous surgical site, accompanied by a low-pressure headache, may lead to the suspicion of durotomy. Focal neurological signs may suggest nerve root incarceration in pseudomeningoceles. Imaging studies, such as magnetic resonance imaging, may localize the lesion but could be

substituted by computed tomography myelography if spinal instrumentation is present.¹

It is reasonable to attempt conservative treatment with bed rest in patients with mild symptoms of incidental durotomy. It has been shown that extended bed rest does not decrease the rate of complications, and therefore patients may resume activity as soon as possible.⁵ Other conservative measures include placement of lumbar subarachnoid drains,¹ percutaneous injection of cryoprecipitate with 10% calcium,⁶ and an ultrasound-guided epidural blood patch.⁷ However, these methods provide only modest results.

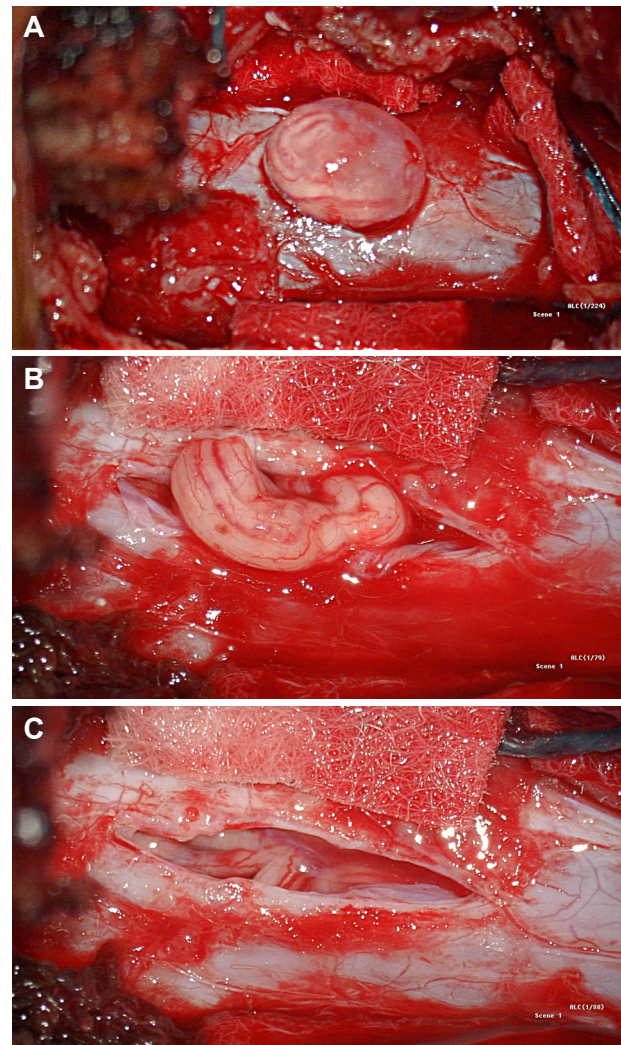


Fig. 2 (A) The pseudomeningocele containing incarcerated nerve roots seen under the operating microscope. (B) After extirpation of the pseudomeningocele, the nerve roots became free of pressure. (C) The nerve roots were replaced through the dural defect into the thecal sac.

It should be noted that > 55.6% of patients do not improve upon conservative treatment with bed rest and eventually require surgical intervention as a definitive treatment.⁶ Therefore, shortening bed rest in favor of surgical intervention can reduce a patient's length of stay and the cost of aftercare.^{5,6} When surgical intervention is performed, pseudomeningocele extirpation, replacement of incarcerated nerve root through the dural defect into the thecal sac, and direct dural repair are the gold standard of management. A direct dural repair can be accomplished with or without fibrin glue, dural substitutes, or myofascial flaps.^{8,9}

A total of 112 articles published between 2012 and 2022 were found in PubMed regarding pseudomeningocele formation after lumbar spine surgery. Six articles describing 7 cases of nerve root incarceration have been published, with our case being the eighth of all cases to be ever reported. Table 1 summarizes these case reports. Revision spine surgery, laminectomy, and older age have been identified as risk factors for incidental durotomy in previous literature reviews.³ However, including our patient, two out of eight patients underwent lumbar surgery prior to the index surgery, causing incidental durotomy and pseudomeningocele formation.^{8,10} Given the advancement in surgical techniques and variability in surgeon preference, only two out of eight patients underwent laminectomy surgery.¹¹ The mean age of patients who suffered from pseudomeningocele with nerve root entrapment in our review was 50.9 years (range 30 – 66).

As previously mentioned, fusion, foraminectomy, and a lateral surgical approach have been identified as protective factors against incidental durotomy.³ Two patients received a percutaneous endoscopic lumbar discectomy (PELD).^{12,13} All patients underwent posterior surgical approaches,^{8,10-14} with one patient undergoing revision fusion.¹⁰ Notably, it was difficult to judge from the description of the reviewed literature how the last remaining

procedure¹⁴ was precisely performed from the author's description.

The timing of the pseudomeningocele diagnosis varied between postoperative day 5 and almost 2 years after the operation. Of eight patients, four presented with postural headaches,^{8,10,11} four presented with back pain and radiculopathy,^{8,12-14} and two presented with lower limb weakness.^{8,10} Nerve root herniation was noted in all 8 cases.

Primary repair was performed in seven of eight cases^{8,10-14} while one author did not detail his method of repair.¹⁴ Five out of eight cases^{8,11,13,14} utilized additional reinforcements such as Duragen Plus, Tisseel, dural sealant, and macropore mesh to repair the pseudomeningocele. One case required multiple procedures, and a percutaneous fat graft¹⁰ was the final method that successfully repaired the patient's pseudomeningocele.

No functional outcome data have been described given the rare albeit serious complication of pseudomeningocele formation, especially those with nerve root incarceration. However, incidental durotomies have been reported to have no impact on long-term outcomes in affected patients.¹⁵ Further large-scale and long-term follow-up studies are necessary to elucidate the long-term outcomes of patients who have received treatment for pseudomeningocele complicated with nerve root incarceration.

On a technical note, surgeons must be mindful of bony decompression. Patients are usually operated on in one position during lumbar spine procedures, most commonly in the prone position. Sharp bony edges may violate the dura once the patient changes position or resumes activities of daily living. Therefore, care should be taken to ensure that all bony edges that may come in contact with the dural surface are smooth.

In conclusion, incidental durotomies should be treated as soon as possible to prevent further complications, such as pseudomenin-

Table 1. Review of case reports describing pseudomeningocele formation with nerve root incarceration after lumbar spine surgery.

Author (Year of Publication)	Patient age and gender (years, M/F)	Prior surgeries	Diagnosis	Procedure performed	Complications and management	Time between procedure and pseudomeningocele formation	Presenting signs and symptoms	Intraoperative findings	Final method of repair
Fransen P, et al. ¹¹ (2015)	66, M	None	L4 – S1 central canal stenosis	Surgical canal recalibration with “window technique”	Uneventful	5 days	Postural headaches	Nerve root herniation at left L5 level	Primary repair with 6 – 0 sutures Reinforced with Liquiband and Tisseel
Santangelo G, et al. ¹⁰ (2017)	64, F	T11 – L4 fusion in 2000 Revision surgery in 2005	Not mentioned	Revision fusion in 2013	Incidental durotomy Primary repair with Profene sutures Reinforced with Duragen patch, gelfoam, and muscle graft	Almost 2 years	Positional headaches Right leg weakness	Nerve root herniation at L4 – L5 level	Percutaneous fat graft after multiple failures
Alvarez CM, et al. ⁸ (2017)	39, M	Multiple L4 – L5 laminectomy and discectomy	Peri-instrument abscess formation	Hardware removal and drainage placement	Incidental durotomy, Epidural blood patch and lumbar drainage	At least 1 month	Headache, Intractable back pain Difficulty sitting up and walking	Scarred nerve roots adhering to the wall of pseudomeningocele	Primary repair with 4 – 0 sutures Macropore mesh fixed with 6 absorbable screws Reinforced with Hydrogel dural sealant
Shu W, et al. ¹² (2018)	52, M	None	L4 – L5 HIVD	Transforaminal PELD at L4 – L5	Uneventful	6 weeks	Right leg pain with radiculopathy	Nerve root herniation and intraoperative entrapment	Primary repair with non-resorbable suture

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Table 1. Review of case reports describing pseudomeningocele formation with nerve root incarceration after lumbar spine surgery. (continued)

Quillo-Olvera J, et al. ¹³ (2018)	61, F	None	Right L4 – 5 and L5 – S1 HIVD	PELD at Right L4 – L5 and L5 – S1	Infected pseudomeningocele Antibiotics	13 days	Low back pain with right side radiculopathy <i>S. aureus</i> bacteremia	L4 nerve root fixed by adhesions L5 nerve root herniation	Primary repair with watertight suture Reinforcement with fibrin-collagen patch and dural sealant
Rahimizadeh A, et al. ¹⁴ (2019) Case 1	30, F	None	Left L5 – S1 HIVD	L5 laminectomy	Uneventful	1 year	Recurrent lumbar complaints	Nerve root herniation	Direct closure of the dural defect
Rahimizadeh A, et al. ¹⁴ (2019) Case 2	51, F	None	Lumbar stenosis	Multilevel laminectomy	Uneventful	15 months	Lower back pain	Two nerve root herniations	Appropriate closure
Winardi W, et al. (2022)	44, F	None	L5 – S1 HIVD	Bilateral L5 laminotomy	Uneventful	18 days	Postural headache Perineal pain and numbness Voiding difficulties and stool incontinence	Nerve root herniation and incarceration	Primary repair with 6 – 0 Prolene sutures Reinforced with Duragen Plus

M: Male.

F: Female.

HIVD: Herniated intervertebral disc.

PELD: Percutaneous endoscopic lumbar discectomy.

gocele formation with nerve root incarceration. This may avert unknown neurological consequences and improve functional recovery.

Author Contributions

Study Design, K.L.; Data Collection, W.W.; Manuscript Preparation, W.W.; Literature Search, W.W.; All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

Ethical review and approval were waived for this study since our patient received standard-of-care treatment.

Informed Consent Statement

Informed consent was waived due to the retrospective nature of our case report and review of literature.

Data Availability Statement

Not Applicable.

Conflicts of Interest

The authors declare no conflict of interest.

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