



# Spinal Cord Herniation into a Pseudomeningocele—A Delayed Presentation following a Traumatic Cervical Root Avulsion Injury

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## Abstract

**Background** Spinal cord herniation into a traumatic pseudomeningocele is a rare clinical entity. We present the sixth known case and describe surgical management.

**Case Presentation** A 44-year-old male presented with Brown-Sequard syndrome three decades after a cervical nerve root avulsion injury. Imaging revealed hemicord herniation into a C7/T1 pseudomeningocele in addition to extra-axial cord compression from further pseudomeningoceles. Significant clinical improvement was achieved following surgical repair. The radiological findings and technique for operative repair are described.

**Conclusion** The case highlights this rare pathology and presentation, describes the surgical measures for repair of cord herniation, and provides evidence for the favorable outcome that can be achieved by surgical intervention.

## Keywords

- ▶ pseudomeningocele
- ▶ herniation
- ▶ spinal cord
- ▶ trauma

## Case History

A 44-year-old male driver was referred with a 1-year history of progressive left lower limb weakness. He had suffered a traumatic left cervical nerve root avulsion in a road traffic accident 31 years ago; this had left his left upper limb paralyzed with phantom limb pain.

Examination revealed a hyper-reflexic spastic paresis in his left lower limb with a T8 crossed sensory level consisting of ipsilateral loss of fine touch and vibration sense, and contralateral loss of pinprick sensation; he had a clinical Brown-Sequard syndrome. A whole spine magnetic resonance imaging (MRI) scan was acquired to include whole spine sagittal and axial T1 and T2 sequences (4 mm slice thickness) and whole spine axial T2 short-tau inversion recovery (2 mm slice thickness) imaging.

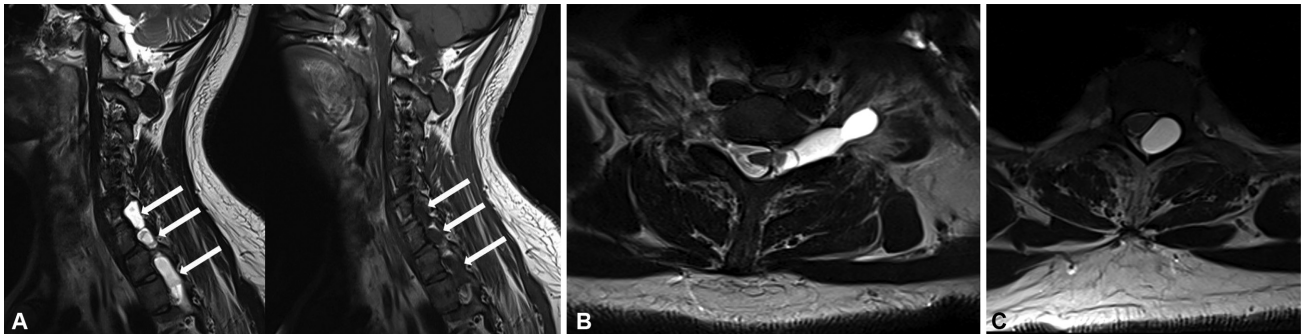
MRI revealed three large left-sided pseudomeningoceles extending through the nerve root foramina at C6/C7, C7/T1, and T1/T2 levels. There was herniation of the left hemicord into the C7/T1 pseudomeningocele with intraspinal extradural extension of the T1/T2 pseudomeningocele caudally to the T3/T4 disc level, displacing the theca anterolaterally with mild cord indentation (effectively an extra-axial compression) (▶ **Fig. 1**).

The patient was keen for surgical intervention due to his progressive loss of function in the lower limbs. The surgery was performed with multimodal intraoperative monitoring. The dura was opened and spinal cord herniations through the dural defects on left side at C6/7 and C7/T1 were exposed. Under magnification, the dural defects at necks of the pseudomeningoceles were extended cranially and caudally

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**Fig. 1** Preoperative images. (A) Sagittal T1- and T2-weighted images demonstrate multiple pseudomeningoceles (white arrows) through left-sided cervical and upper thoracic nerve root foramina. (B) Axial T2-weighted image shows herniation of the left side of the spinal cord (black arrow) through dura (white arrow) approximately at the level of the C7 vertebra. There is mild increased signal through the herniated portion of the cord due to edema. (C) Axial T2-weighted image shows intraspinal extradural pseudomeningocele causing displacement of the spinal cord to the right, caudal to the level of cord herniation.

to allow safe release of gliotic herniated spinal cord from these dural defects. The spinal cord was fully released into the intradural spinal canal. The pseudomeningocele defects were closed with 5–0 Prolene sutures in a watertight fashion. The overlying soft tissues were closed in layers as normal (► Fig. 2).

Follow-up at 3 months revealed a return of power to the left leg and MRI demonstrated anatomically successful surgery. His left arm phantom limb pain remained unchanged from his preoperative state (he had had this for several years); he awaits assessment by a functional neurosurgery for this.

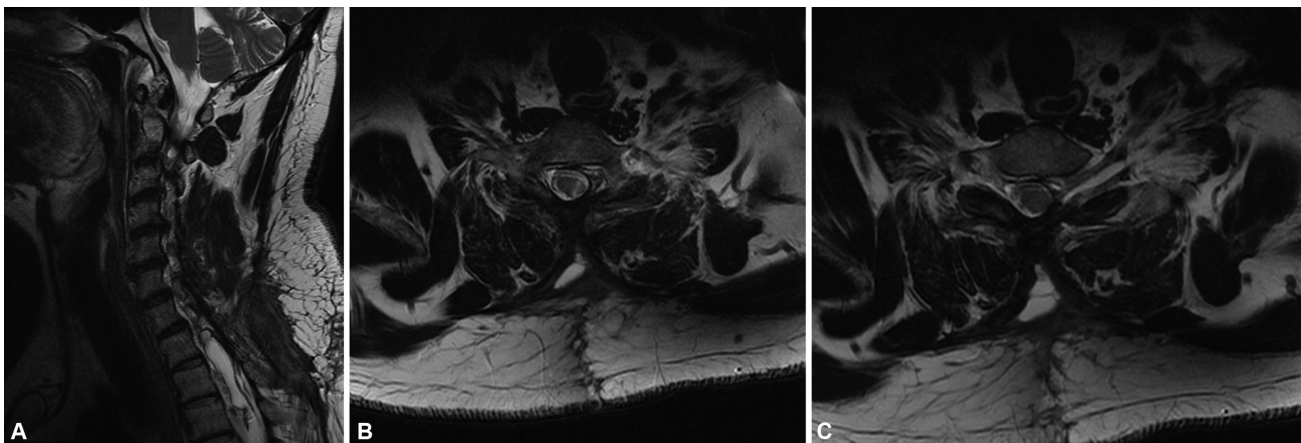
## Discussion

Symptomatic spinal cord herniation into a post-traumatic pseudomeningocele is rare but of clinical importance. It is disabling but a potentially treatable condition<sup>1,2</sup> Our case is made more interesting by the rare lateral direction of herniation and the clinical Brown-Sequard syndrome it produced; but the concept applies to any unexplained myelopathy with a history of trauma and the diagnosis should be considered.

Traumatic spinal cord herniation is a very rare entity, with only 13 cases reported previously.<sup>1–6</sup> Pseudomeningoceles arising from nerve root avulsions are a particularly rare subtype of post-traumatic pseudomeningocele and we are only aware of five similar cases (only two of which presented as Brown-Sequard syndrome).<sup>2–6</sup> In interesting contrast, Brown-Sequard syndrome is the most common presentation of idiopathic cord herniations.<sup>6</sup> However, it should be noted that idiopathic herniation is a rare entity in its own right.

Our literature search regarding post-traumatic pseudomeningoceles suggests that abnormal neurological symptoms may develop several years after the initial injury; herniation may be a gradual process related to hydrostatic pressures. Indeed, it has been postulated in previous case reports that a persistent cerebrospinal fluid (CSF) leak can, over many years, lead to the formation of a cyst like adhesion cavity around the pseudomeningocele; subsequent CSF pulsations encourage the cord to herniate into this.<sup>6</sup>

In the context of delayed post traumatic myelopathy, the clinician must take reasonable measure to exclude this diagnosis. In current practice, MRI is the investigation of choice; three-



**Fig. 2** Postoperative images at 6 months. (A) Sagittal T2-weighted images show marked regression of the pseudomeningocele at the level of surgery. (B) Axial T2-weighted image shows intradural position of the cord. There is a linear high signal intensity in the left hemicord at this level which at 6 months is likely due to gliosis especially in the context of associated volume loss. (C) Axial T2-weighted imaging showing caudal displacement of the spinal cord.

dimensional sequences/volume data and thin slice images can be acquired to aid data reconstruction. These may also be of use in surgical planning. In certain cases, computed tomographic myelography can be an aid in establishing the diagnosis of spinal cord herniation or in differentiating pseudomeningoceles from arachnoid cysts or arachnoid bands.

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#### Conflict of Interest

None declared.

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