




Image Report

Pedicled multifidus muscle flaps to treat dural tears due to penetrating spinal stab wounds: Two case reports and a literature review

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ABSTRACT

Background: Penetrating spinal injuries occasionally lead to dural tears (DT) and cerebrospinal fluid (CSF) leaks that risk both infectious and neurological complications. Here, we reviewed two cases and the literature regarding the safety/efficacy and limitations of repairing traumatic DT utilizing pedicled multifidus muscle flaps.

Case Description: Two males, ages 73 and 50, presented with Brown-Sequard syndromes and DT/CSF fistulas attributed to knife-induced spinal injuries at the D3–D4 and D11–D12 levels. Intraoperatively, DT was repaired utilizing pedicle multifidus muscle flaps. Postoperatively, both patients demonstrated partial recovery of neurological function along with no residual symptoms/signs of DT/CSF fistulas.

Conclusion: Penetrating traumatic spinal injuries may result in DT/CSF fistulas that can be adequately repaired utilizing pedicle multifidus muscle flaps.

Keywords: CSF leakage, Dural tear, Pedicled multifidus muscle flap, Penetrating spinal injury, Spine surgery

INTRODUCTION

Penetrating spinal injuries may result in dural tears (DT)/cerebrospinal fluid (CSF) leaks that can result in wound infections, meningitis, and abscesses.^[2,3,6,8] Although direct dural suturing is the gold standard for repairing DT,^[5] non-suturable lacerations may require indirect dural repair utilizing grafts and/or pedicle multifidus muscle flaps.^[1,4,10] Here, we reviewed two cases [Table 1] and the literature defining the safety, efficacy, pros and cons of utilizing grafts and/or pedicle multifidus muscle flaps to repair spine-trauma-related DT/CSF fistulas.

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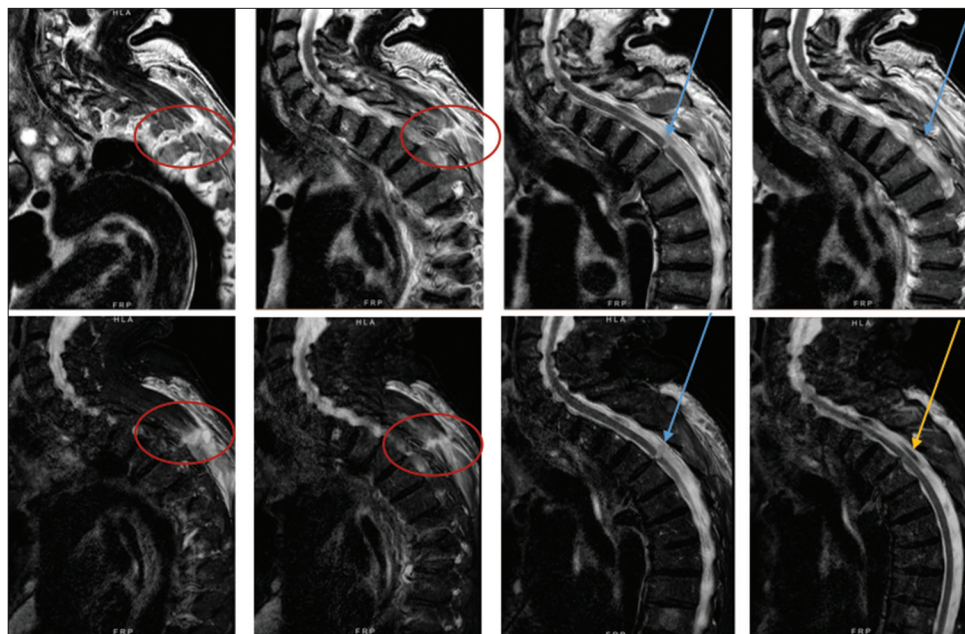


Figure 1: Spinal magnetic resonance imaging of patient 1. Upper row: sagittal slices, T2-weighted sequences. Lower row: sagittal slices, short-tau inversion recovery sequences. Red circles indicate a fracture of the articular facet and a laceration of the yellow ligament on the left. Blue arrows indicate the spinal cord lesion; yellow arrow indicates subdural hematoma.

CASES DESCRIPTIONS

Case 1: Clinical presentation

A 73-year-old male presented with paraparesis (left plegic; right paretic), hypoesthesia from the chest down, and a CSF leak following a posterior T3–T4 knife wound. The magnetic resonance (MR)-documented a left T3–T4 ligamentum flavum laceration, a dural tear, and a thin left-sided posterolateral T2–T5 subdural hematoma (SDH). The computed tomography (CT) showed a fracture of the left upper T3 facet joint [Figures 1 and 2].

Surgery

A left-sided T4 hemilaminectomy and partial T3–T5 hemilaminectomies allowed for the removal of the SDH. However, the significant lateral/foraminal and anterolateral DT/CSF leak was non-suturable and required an indirect dural repair using the CO₂ laser and a pedicled multifidus muscle flap.^[10,11]

Postoperative course

Postoperatively, the patient was placed on seven days of cefazolin, during which time the motor function of the right lower extremities improved, but the left remained plegic. The postoperative magnetic resonance imaging (MRI) confirmed adequate thoracic cord decompression and appropriate placement of the pedicled multifidus muscle flap repair [Figure 3]. Six months later, the American Spinal

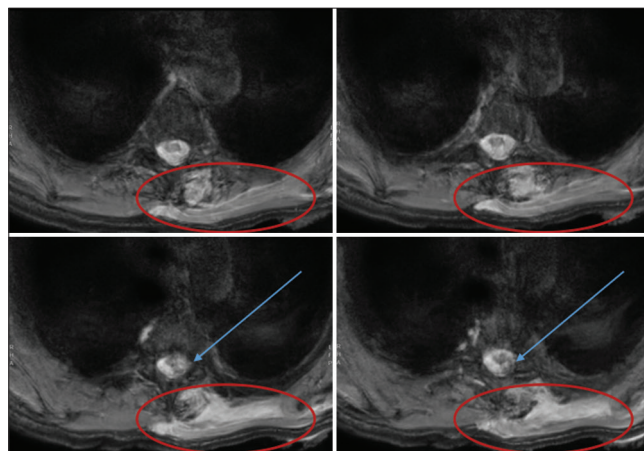


Figure 2: Spinal magnetic resonance imaging of patient 1. Axial slices, short-tau inversion recovery sequences. Red circles indicate a fracture of the articular facet, a laceration of the yellow ligament, and a contusion of the paravertebral tissues on the left. Blue arrows indicate the spinal cord lesion.

Injury Association Impairment Scale (AIS) score was C (i.e., Grade C: Incomplete motor function preserved below the neurologic level; more than half of the key muscles grade <3 not anti-gravity).

Case 2

Twenty-four hours after a stab wound at the D11–D12 level, a 50-year-old male presented with right lower extremity paralysis, bilateral lower extremity sensory deficits, and

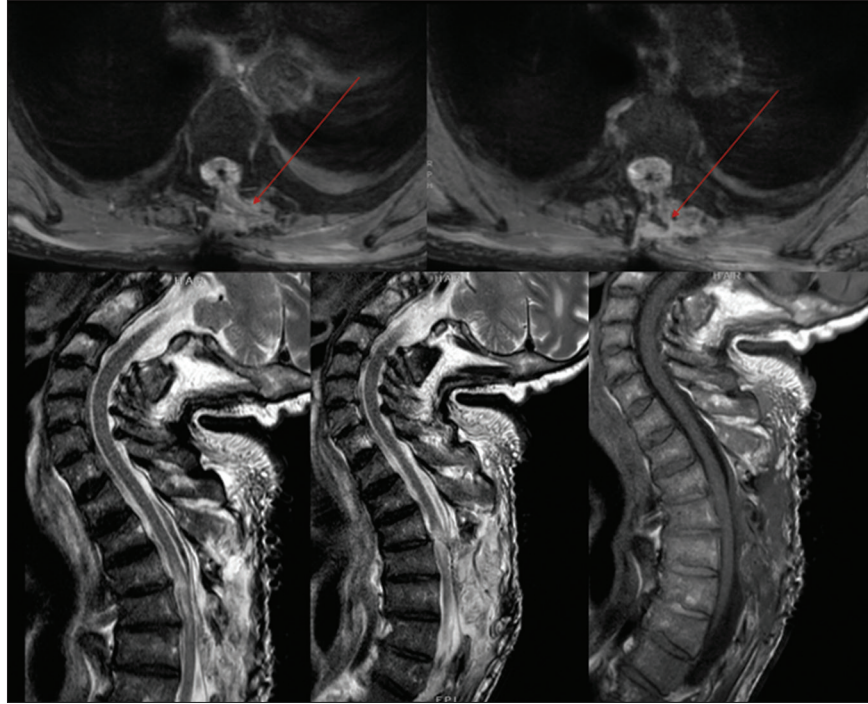


Figure 3: Postoperative magnetic resonance imaging of patient 1 (axial and sagittal views). Red arrows indicate the multifidus muscle flap rotated over the dura mater.

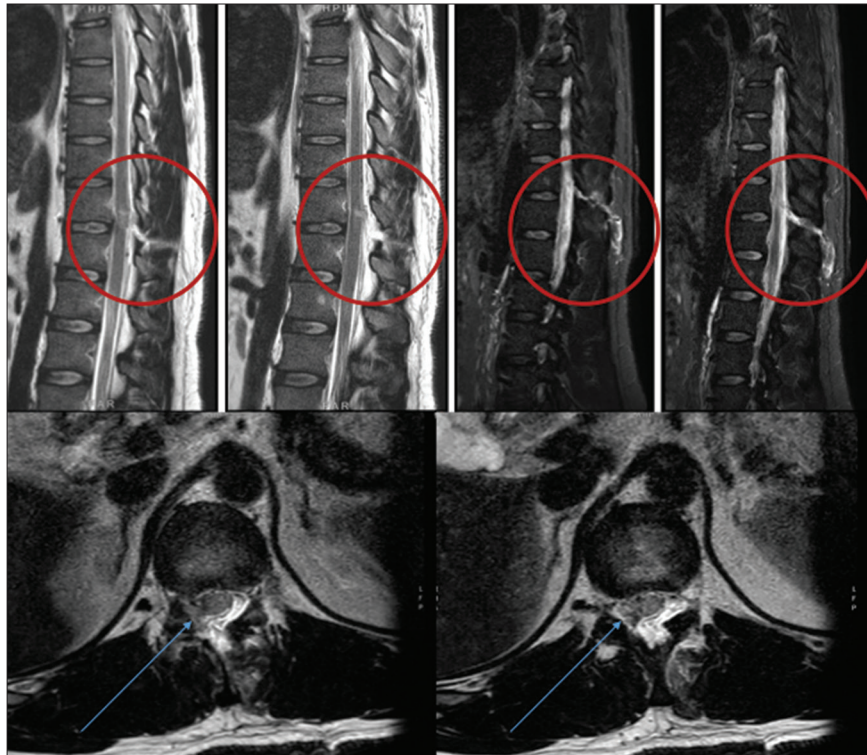


Figure 4: Spinal magnetic resonance imaging of patient 2, sagittal and axial scans. Red circles indicate the laceration of the yellow ligament and the interspinous ligament with signs of a cerebrospinal fluid fistula (hyperintensity in the short-tau inversion recovery sequences and a small fluid collection in the subcutaneous tissue). Blue arrows indicate the lesion on the posterior-lateral side of the thecal sac.

Table 1: Patients' details.

Age (years)	Sex	Neurological examination	Level of injury	Skin wound	RFB	Visceral lesions	Neuroimaging (CT, MRI)	Dural tear	CSF leakage	Surgery	Outcome	6 months outcome (AIS)	
Patient 1	73	Male	Paresis in the left lower limb (F1), and mild paresis in the right lower limb (F4). Hypoesthesia in the right hemithorax, neuropathic pain in the lower limbs.	T3-T4	Left paramedian, the blade had been deflected by the scapula toward the spine.	No	None	Fracture of the left upper facet joint of T3/tear in the ligamentum flavum/left T3-T4 cord laceration/subdural hematoma T2-T5	Anterolateral; spinal root involved	Immediate	Urgent/Hemilaminectomy	No complication/no CSF leakage	C
Patient 2	50	Male	Paresis in the right lower limb (F2), bilateral sensory deficits (left>>right) up to a mid-dorsal upper level.	T11-T12	Right paravertebral	No	None	Tear in the right yellow and interspinous ligaments at the T11-T12 level/laceration on the right posterolateral part of the cord	Posterior-lateral-anterior	Delayed (12 h)	Urgent/laminectomy	No complication/no CSF leakage	D

CT: Computed tomography, MRI: Magnetic resonance imaging, CSF: cerebrospinal fluid, AIS: Association impairment scale, RFB: Retained foreign body

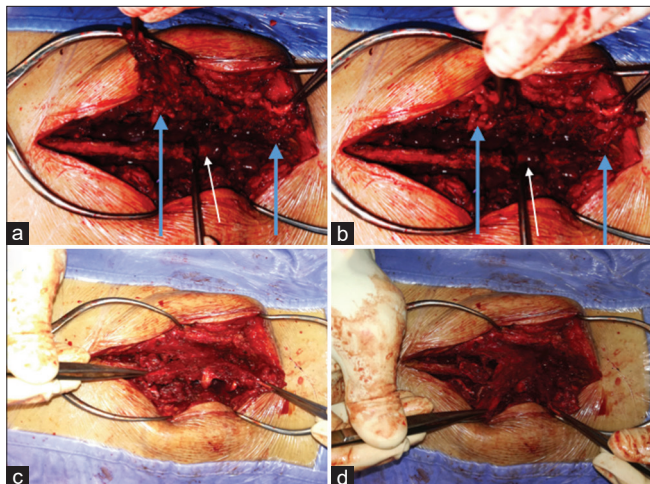


Figure 5: Intraoperative pictures of patient 2 showing the harvesting of the pedicled multifidus muscle flap. (a and b) show the flap already harvested on the left side, with blue arrows indicating the cephalad and caudal extremities of the flap and a white arrow showing the exposed dura mater at the level of the laminectomy. (c and d) display the flap rotated to cover the dura mater, filling the laminectomy, with yellow arrows indicating the pedicle of the flap, which is attached at the level of the intertransverse space.

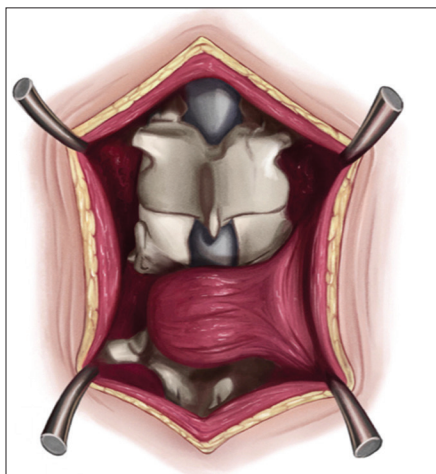


Figure 6: A diagram representing the prepared flap rotated to cover the dura mater.

a DT/CSF leak. The thoracic CT scan showed no retained metallic fragments or bony pathology. The MRI showed a tear in the right yellow/interspinous ligaments at the D11–D12 level, a laceration of the right posterolateral cord, and a DT/CSF with CSF extending into the paravertebral muscles [Figure 4].

Surgery

The bilateral D11 laminectomy documented multiple posterolateral/anterolateral nonsaturable dural lacerations and a minor spinal cord “tear.” Here, too, the dura was

indirectly repaired by rotating pedicled multifidus muscle flaps [Figure 5].

Postoperative course

Postoperatively, the patient’s right lower leg motor function improved, but the sensory deficit remained unchanged. He received a 7-day course of cefazolin. The postoperative MR and clinical examinations showed no recurrent CSF leak. Twelve days later, when the wound was fully healed, the patient was transferred to a rehabilitation unit. At six postoperative months, he qualified for the American Spinal Cord Injury Association (AIS) score of D (i.e., motor grade of at least three below the neurologic level of injury).

DISCUSSION

Dural repairs for penetrating spinal injuries, including multifidus muscle flaps

Conservative management of DT/CSF leaks risks wound infections, meningitis, septicemia, and death.^[9] Therefore, most penetrating spinal injuries are treated surgically utilizing laminectomy, resection of retained foreign bodies, including knife blades, removal/decompression of hematomas, and exploration/watertight closure involving direct/indirect dural repairs.^[2,3,6,8]

Lack of success with spinal drain placement for these DT/CSF fistulas has included overdrainage, pneumocephalus, intracranial hemorrhages, and meningitis (i.e., 3–8%).^[2,7] Rather, pedicle multifidus muscle flaps are effective alternatives for managing such penetrating spinal dural lacerations [Figures 5 and 6].^[10,11]

CONCLUSION

Traumatic spinal cerebro spinal fluid (CSF) leaks/DT following penetrating spinal cord injuries may require indirect readily provided by utilizing pedicle multifidus muscle flaps.

Ethical approval

The Institutional Review Board approval is not required.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of AI-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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