



Case Reports & Case Series

Circumferential dural reconstruction after excision of recurrent intradural extra medullary spinal meningioma

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ABSTRACT

Background: Meningiomas are the most common benign spinal tumor. Surgery is mostly curative, however, ~10% of benign spinal tumors recur. Meningioma recurrence is associated with dural invasion, degree of resection, and histological characteristics of the tumor. Resection of large ventral spinal tumors remains challenging due to a greater risk of spinal cord injury and difficult proper tumor exposure. Surgical resection techniques include en bloc resection of the tumor and involved dura, or tumor resection with extensive coagulation of the dural bed. This is the first report of successful circumferential spinal dural repair using a synthetic dural graft following resection of a recurrent WHO Grade I thoracic spinal meningioma in a pediatric patient. **Case description:** We report our technique for 360° duraplasty of the thoracic spine following meningioma excision in a pediatric patient. The patient is a neurologically intact 17-year-old female presenting with intradural extra medullary (IDEM) WHO Grade I recurrent ventral thoracic spinal meningioma at the T10–T11 level with intraoperative evidence of nerve root invasion for which complete resection was performed. The resultant 5 cm circumferential dural defect necessitated 360° spinal thoracic duraplasty. No postoperative cerebrospinal fluid leak (CSF) or other complications related to the repair were encountered and the patient returned to baseline neurological status postoperatively.

Conclusions: Further follow-up will provide long-term results of this procedure and further research on the application of this technique in dural repair during different surgeries at all spinal levels is warranted.

1. Introduction

Meningiomas are the most common benign spinal tumor. Surgery is curative in a majority of cases, and although ~10% of benign spinal tumors recur; the recurrence is associated with incomplete resection in all instances [1]. Gross total resection remains the recommended treatment over radiotherapy for initial treatment [2]. It is, therefore, important to achieve optimal resection to minimize recurrence risk, especially in highly invasive tumors. Surgical options described in the literature include en bloc resection of the tumor and involved dura, or tumor resection with extensive coagulation of the dural bed; both techniques offer comparable results, with a slightly higher chance of recurrence for the latter [3].

Various approaches to spinal tumor resection have been described and should be tailored to case specifics. Generally, posterior approaches decrease the likelihood of developing spine instability and are less invasive [4].

After resection of the involved dura, especially of dural sac, dural repair is a challenge. Here we present circumferential dural reconstruction after excision of recurrent IDEM spinal meningioma.

2. Case report

2.1. Clinical presentation

Patient is a 17-year-old Caucasian female who first presented at age 13 with back pain that was mistakenly diagnosed as a stress fracture. Soon she developed abdominal pain that progressed over a course of 6 months into sharp shooting pain in her flanks and lower back. This was associated with a 10 pound weight loss over 4 weeks, bilateral lower limb weakness, numbness, tingling, hyperreflexia, and balance issues necessitating assistance for mobility. Magnetic resonance imaging (MRI) of the spine showed a T10–T11 ventral IDEM lesion (Fig. 1 A and B). Simpson Grade II resection through a costovertebral approach

Abbreviations: CSF, cerebrospinal fluid; IDEM, intradural extra medullary; JP, Jackson Pratt; MRI, magnetic resonance imaging

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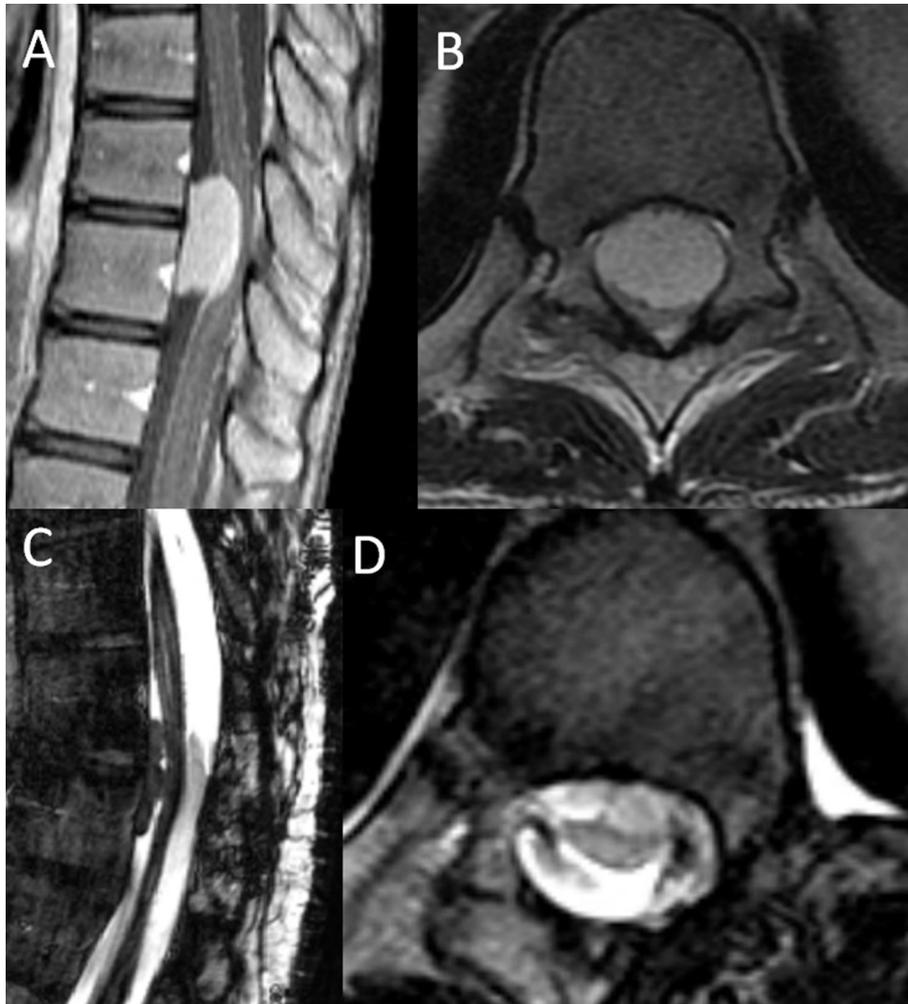


Fig. 1. MRI images of original tumor (A and B) and recurrent tumor (C and D).

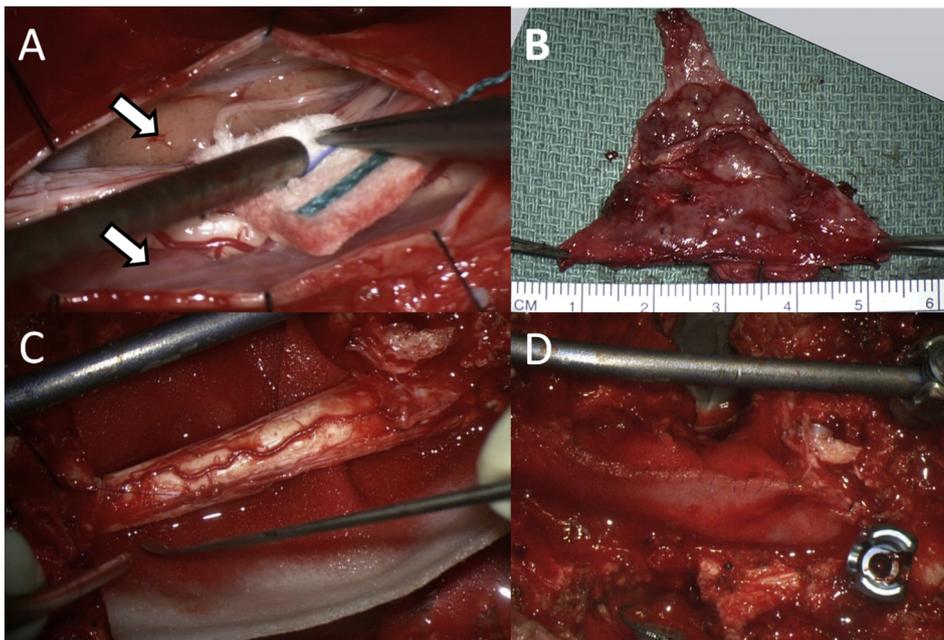


Fig. 2. Pale yellow-gray tumor (arrows) adherent to the thecal sac was wrapping ventrally to the right side of the spinal cord and extending from inferior portion of T9 to the superior portion of T11(A). Resected tumor and involved dura(B). Dural sac reconstruction with DuraMatrix® (C and D). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

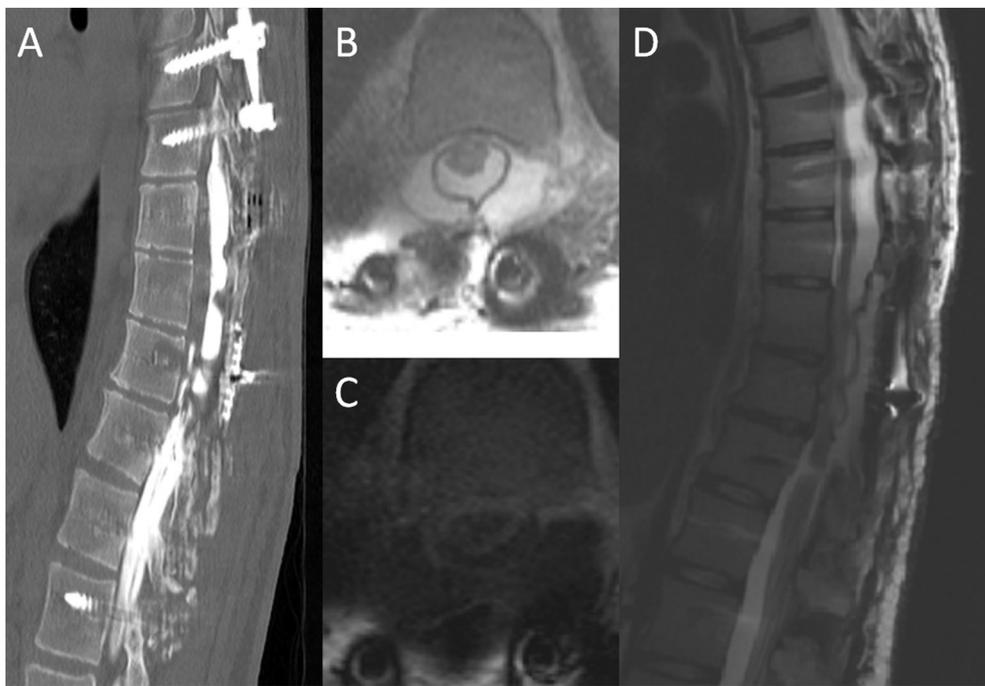


Fig. 3. CT myelograph showing dural graft in place at T10/11 and no evidence of CSF leak (A). MRI thoracic spine showing circumferential dural reconstruction with complete removal of tumor (B). MRI images of 3-month follow-up showed intact hardware and stable epidural collection with no further evidence of CSF leak (C and D).

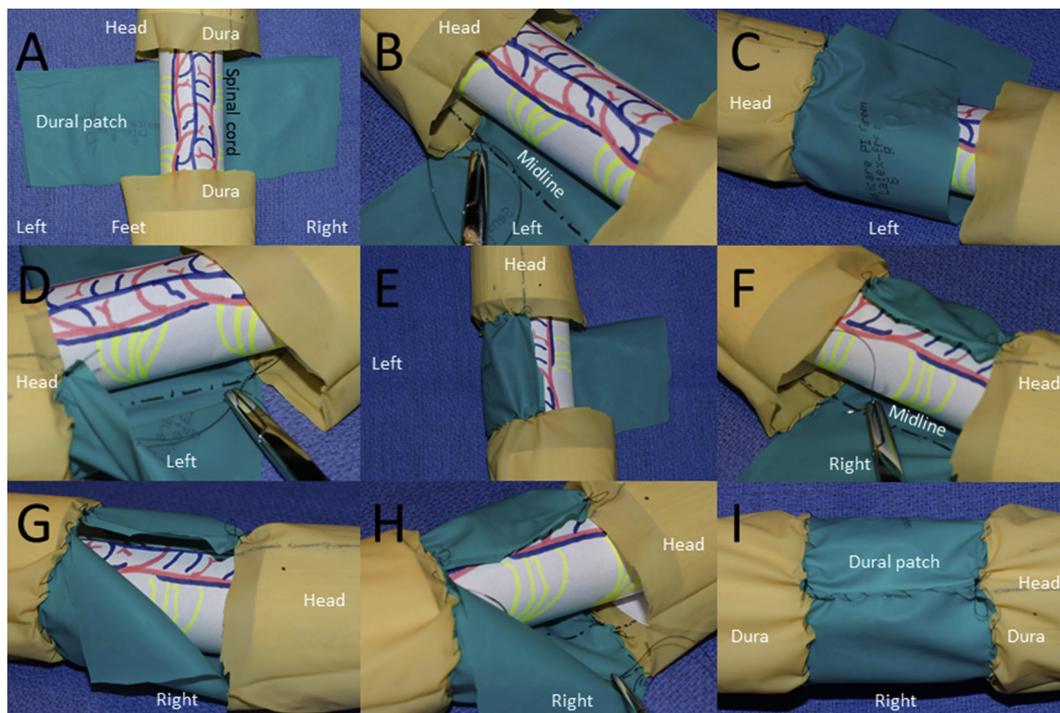


Fig. 4. A. After the tumor and involved dura were removed, a piece of dural substitute was laid in place. B. To avoid moving the spinal cord, the midlines of dura and dural patch were pulled to the left side of the spinal cord. We sutured the dural patch to the left half of cranial dural sac. C. The left side of cranial portion was closed. D. While the midlines of dura and dural patch were pulled to the left side of the spinal cord, we sutured the dural patch to the left half of caudal dural sac. E. The left side of was closed. F. While the midlines of dura and dural patch were pulled to the right side of the spinal cord, we sutured the dural patch to the right half of caudal dural sac. G. The right side of caudal portion was closed. H. While the midlines of dura and dural patch were pulled to the right side of the spinal cord, we sutured the dural patch to the right half of cranial dural sac. I. After the midline of the dural patch was closed, we completed the circumferential dural reconstruction.

was done, which relieved the patient's back pain, and motor and sensory dysfunction. Pathological analysis confirmed the diagnosis of a WHO Grade I spinal meningioma with a high proliferative index.

Routine follow-up MRI 3 years later showed a ventral plaque-like enhancing dural thickening at the T9–T10 level that was not associated with any clinical changes. Over the course of 10 months, the lesion demonstrated slow growth suggestive of recurrence (Fig. 1C and D).

Even though the possibility of a residual was considered, the authors believe complete resection was achieved with the first procedure. A decision was made to surgically resect the lesion.

2.2. Surgical technique and follow-up

Once under general anesthesia a lumbar drain was placed then

patient was positioned prone on open Jackson table. Patient's previous incision was extended 3 levels superiorly and inferiorly for exposure from T6 to L1. Pedicle screws from T6–8 and T11–L1 were placed (CD Horizon® Legacy™ Spinal System, Medtronic Sofamor Danek USA, Inc., Memphis, TN). Previous T11–12 laminotomy screws and plates were visualized, however the laminectomy was extended both superior and inferior to allow for greater visualization. An en bloc laminectomy from T9–T11 was performed followed by bilateral costotransversectomy with resection of the posterior third of T10 allowing for 360° visualization of the thoracic cord. Unilateral temporary rods were alternated throughout the procedure to allow for visualization while providing stability. The thecal sac was opened at the midline revealing a soft yellow-gray tumor that was wrapped around ventral part of spinal cord and several nerve roots (Fig. 2A). The individual nerve roots were dissected out and tested with direct stimulation. Once proven to not have motor function they were sacrificed. The lesion and dura were resected en bloc as it wrapped around the thoracic cord (Fig. 2B). A dural substitute (3 × 3 in. DuraMatrix® Sutureable Collagen Dura Membrane, Stryker Corporation, Kalamazoo, MI) was then passed under the ventral surface of the spinal cord. Suturing was initiated at the ventral surface and brought along the left superior edge until the midline, followed by the inferior edge of the ventral surface along the left side. Then, starting at the superior ventral knot, the superior right edge was sutured until at midline followed by the inferior right edge. The excess DuraMatrix® was removed and the midline opening was closed. Edge to edge approximation of the DuraMatrix® was performed using 5-0 Prolene (Fig. 2C and D). Traction on the freely mobile edge of the DuraMatrix® being sutured at midline allowed for minimal cord retraction during the procedure, A Valsalva maneuver was performed to 40 without evidence of cerebrospinal fluid (CSF) leak. Tissue sealant (DuraSeal® Xact Spine Sealant System, Integra Life Sciences Corporation, Plainsboro, NJ) was then sprayed over the construct. Permanent rods were placed; the previous laminectomy was fashioned to cover the entire posterior defect and secured in place with a crosslink. A 10 French Jackson Pratt (JP) drain was left and the fascia and skin was closed.

The JP drain was kept for 10 days and the lumbar drain for 17 days. Postoperatively the patient was neurologically intact apart from left lower extremity weakness at the hip flexor level (3/5) that improved to (4/5) prior to discharge home. Postoperative imaging showed an epidural fluid collection that had no intradural communication on myelography demonstrating no evidence of CSF leak (Fig. 3 A and B). Final pathology was consistent with a WHO Grade I meningioma with focal superficial bone invasion.

At 3 months follow up she complained of mild weakness, numbness and patchy loss of temperature sensation of the right lower extremity. On examination she was neurologically intact apart from left hip weakness (4/5), bilateral Babinski reflex, decreased pain sensation in the right calf and loss of sensation to the T10 dermatome bilaterally. Her surgical incision was well healed and there was no sign of fluid collection. Imaging showed intact hardware and stable epidural collection with no further evidence of CSF leak (Fig. 3C and D).

We used a model to demonstrate technique of this circumferential dural reconstruction. (Fig. 4).

3. Discussion

Despite the potential role of radiotherapy for treatment of meningiomas, its usage remains limited to higher-grade recurrent lesions in patients who are not fit for surgery and surgical excision remains the mainstay of treatment [2]. Surgical approaches to ventral and ventrolateral spinal tumors depend on the segment of the spinal cord affected and aim to provide optimum visual access needed for total removal without cord retraction. For this purpose, the dorsolateral approach is the most frequently chosen approach for thoracic IDDM tumors [5,6]. In our approach, we found it necessary to excise one-third

of the vertebral body coupled with a traditional dorsolateral approach to properly visualize the tumor allowing for its complete resection and to allow room for appropriate dural closure afterward given the extent of the planned resection. Recurrence has been associated with excision less than Simpson Grade I [3], which in our case given the extent of dural invasion, would not have been possible without appropriate exposure facilitating the performance of circumferential duraplasty after tumor excision. Outcomes of surgery are worse for ventral and ventrolateral tumors, recurrent lesions, and in patients with poor pre-operative function [7]. However, in our case, despite the presence of two risk factors for poor outcomes, 3 months postoperatively the patient could walk unassisted with mild gait disturbance. This could be attributable to minimal intraoperative cord manipulation achievable through appropriate exposure.

To our knowledge, circumferential spinal dural repair following recurrent thoracic meningioma has only been reported once in the literature in which case the repair was achieved using combined fascia lata, bovine pericardial graft, and fibrin glue [8]. Given that CSF leak is a common complication of intradural surgery of the spine and has been shown to be more likely with the use of a combination of different dural substitutes (but not with the use of any single one alone) [9], we report the first circumferential dural repair using a synthetic dural substitute, which allowed for easier graft fashioning and overcoming limited donor-site capabilities that would necessitate the combination of different dural substitutes and predispose to greater morbidity associated with graft harvesting. Even though there are reports of adequate resection of ventral spinal tumors through posterolateral spinal access sparing the vertebral body [10], we could not achieve proper exposure without sacrificing part of the vertebral body.

4. Conclusion

This is the first report of successful circumferential spinal dural repair using a synthetic dural graft following resection of a recurrent WHO Grade I thoracic spinal meningioma. Further follow-up will provide more insights on spine morbidity, if any, associated with the procedure and further research on the application of this technique in thoracic dural-based lesions is warranted.

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Declaration of interest

We wish to confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

We confirm that the manuscript has been read and approved by all named authors and that there are no other persons who satisfied the criteria for authorship but are not listed. We further confirm that the order of authors listed in the manuscript has been approved by all of us.

We confirm that we have given due consideration to the protection of intellectual property associated with this work and that there are no impediments to publication, including the timing of publication, with respect to intellectual property. In so doing we confirm that we have followed the regulations of our institutions concerning intellectual property.

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