

Case Report

Minimally invasive surgical decompression for lumbar spinal metastases

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Abstract

Background: The risk of significant morbidity and mortality often outweighs the benefit of surgical resection as palliative treatment for patients with high systemic disease burden, poor cardiopulmonary status, and previous spinal surgeries. Minimally invasive surgical (MIS) approaches to decompressing metastatic epidural cord compression (MECC) can address these issues and thereby make palliation a feasible option for these patients.

Case Description: We present the cases of three consecutively collected patients with severe neurological compromise secondary to lumbar epidural metastases who underwent MIS decompression and achieved improved functional outcome and quality of life. The first patient is a 23-year-old female with metastatic Ewing's sarcoma who presented with 2 weeks of a right foot drop and radiculopathic pain. The next case is that of a 71-year-old male with metastatic prostate cancer who presented with significant radiculopathic L5-S1 pain and severe motor deficits in his lower extremities. The last case is that of a 73-year-old male with metastatic hepatocellular carcinoma who presented with worsening left leg weakness, paresthesia, and dysesthesia. Postoperatively, each patient experienced significant improvement and almost complete enduring return of function, strength, and resolution of pain.

Conclusion: We demonstrate that MIS approaches to spinal decompression as palliative treatment for metastatic disease is a viable treatment in patients with a focal symptomatic lesion and comes with the benefits of decreased surgical morbidity inherent to the minimally invasive approach as well as excellent functional outcomes.

Key Words: Epidural metastases, Ewing's sarcoma, metastatic, palliation, spinal decompression

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INTRODUCTION

The spine is the most common site of skeletal metastases, which constitute over 90% of spinal tumors.^[22] Symptomatic metastatic spinal disease occurs in up to half of all cancer patients, with one-fifth of

these cases resulting in spinal compression.^[1,23] Improved detection and survival have resulted in an increasing incidence of metastatic cord compression.^[6,19]

Spinal metastases may cause progressive pain, instability, and neurologic deficits. In deciding upon their treatment,

one must consider the type and extent of the tumor, stability, neurologic status, comorbidities, and life expectancy.^[16] Treatment is most often palliative, aimed at relieving pain as well as preserving and restoring neurological function and mechanical stability.^[10,16,20]

Surgical decompression has been shown to have superior outcomes to local radiotherapy in terms of more immediate and lasting functional recovery.^[4,8,18] Indications include symptomatic radioresistant tumors, spinal instability, pathologic fracture, refractory neurologic deficits, and intractable pain.^[1,4] However, even if indicated, traditional surgical approaches are often limited by the patient's life expectancy, prior surgeries, or poor tolerance for surgery arising from comorbidities, malnourishment, or ongoing chemotherapy.^[5,16,23,24]

Owing to advances in microsurgical technique, imaging, and instrumentation over the past few years, the minimally invasive surgical (MIS) approach to the spine presently offers significantly lower morbidity than traditional techniques through minimal tissue disruption, decreased risk of infection, pain, and blood loss, as well as decreased postoperative recovery time.^[2,3,9,11,16,17] This has led to more aggressive interventions for patients with spinal metastases.^[20]

Here we present three hallmark cases of MIS spinal decompression as palliation for symptomatic lumbar metastatic epidural cord compression (MECC) in a select patient cohort with excellent enduring functional outcomes and quality of life.

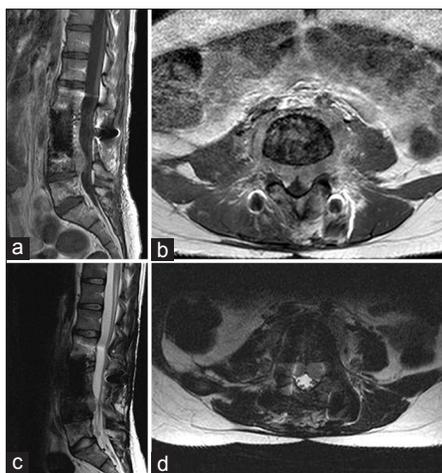


Figure 1: Preoperative T1-weighted (a) sagittal and (b) axial and T2-weighted (c) sagittal and (d) axial MRI reveal enhancing epidural tissue along the posterior aspect of the L4 vertebral body with extension into the L4-L5 foramina bilaterally

Table 1: Patient profiles

Case	Age (years), sex	Diagnosis	Duration of Sx	Level	Procedure
1	23, F	Ewing's sarcoma, metastatic	1 month	L4-L5	Right, single-level, MIS spine tumor resection
2	71, M	Prostate cancer, metastatic	1-3 months	L1-L2, L4-L5	Right, two-level, MIS spine tumor resection
3	73, M	Hepatocellular carcinoma, metastatic	1 month	L3-L4	Left, single-level, MIS spine tumor resection

CASE REPORTS

Case 1: Ewing's sarcoma

This 23-year-old female presented with 1-month of radiculopathic pain and paresthesia in the L5 distribution and foot-drop. She had a 6-year history of Ewing's sarcoma, status post multiple sessions of chemotherapy and radiation with remission and numerous relapses [Table 1]. The patient had known metastatic disease to the L2-L4 epidural tissue and the L4-L5 vertebral bodies, posterior elements, and transverse processes. She was presently on chemotherapy, and in the past had received an L3 corpectomy, cage placement, L3-L4 laminectomy, and L3-L5 posterior spinal instrumentation and fusion 3 years prior. Her last stereotactic radiotherapy session was 4 years ago. Oncology predicted 3 months expected survival.

Preoperatively the patient had 9/10 pain in her right leg with 2/5 strength on dorsiflexion and decreased sensation to light touch in L5 and S1 distributions. Magnetic resonance imaging (MRI) confirmed an enlarging epidural tumor extending from the L2-L4 levels, involving the L4-L5 level, and extending into the L3-L4 and L5-S1 right neural foramina [Figure 1].

The patient underwent right-sided MIS L4-L5 laminotomy, resection of the dorsal and ventral tumor encroaching on the spinal canal, and L5 nerve root decompression by foraminotomy [Figure 2].

Postoperatively, she had immediate resolution of the right L5 radiculopathy and increased strength in right ankle dorsiflexion to 4/5. She was able to walk without foot drag, orthosis, or limp and was discharged the same day without opioid medication [Table 2]. Postoperative MRI demonstrated adequate decompression of L5 nerve root [Figure 3]. The patient was immediately restarted on continuous chemotherapy and received 15 days of radiotherapy to L4.

At 9 months follow-up, she demonstrated 4+/5 strength, with a well-healed incision, and without the need for pain medication.

Case 2: Stage IV prostate cancer

This 71-year-old male presented to the ER with new increasingly severe back and lower extremity pain concomitant with his preexisting lower extremity motor deficits that had persisted for roughly 3 months prior and left him wheelchair bound. His past medical history

Table 2: Preoperative and postoperative patient clinical profiles

Case	Preop motor score of affected level (s)	Postop motor score of affected level (s)	Preop VAS	Postop VAS	Hospital LOS (days)	EBL (cc)	Operative time (min)	Complications	Opioid dosages (mg)	Length to follow-up (months)
1	2/5	4/5	9	0	1	<5	45	None	Preop: 1-hydromorphone 4 mg IV, 2-morphine sulfate 15 mg IV; Postop: None	6
2	2/5	4+/5	9	2	5	10	65	None	Preop: 1-oxycodone ER 100 mg PO, 2-hydromorphone 12 mg IV, 3-morphine sulfate 4 g IV, 4-oxycotin 100 mg PO; Postop: 1-oxycodone ER 100 mg PO	4
3	2/5	3/5	8	2	5	30	90	None	Preop: 1-hydromorphone 6 mg IV, 2-morphine sulfate 8 mg IV, 3-oxycotin 100 mg PO; Postop: 1-hydromorphone 2.4 mg IV	2 weeks

VAS: Visual analogue scale, EBL= Estimated blood loss, LOS= Length of stay



Figure 2: Intraoperative fluoroscopy utilizing MIS retractor (a) K-wire targeting involved disc level (b) Serial dilators were docked onto the facet complex (c) A tubular dilator was used, which was angled rostral (d) and caudal (e) to access the extent of tumor

was significant for metastatic castration-resistant prostate cancer diagnosed roughly 20 years prior. He was status post several operations for spinal metastatic disease including decompression of T5-T11 epidural tumor involvement, and a T8 transpedicular corpectomy with T5 to T11 instrumentation for pathologic burst fracture. Imaging of his lumbar spine demonstrated L1-L2 vertebral body metastasis with bilateral L2 foraminal compression [Figure 4]. Systemically, patient had pulmonary edema secondary to pulmonary metastatic disease. Oncology estimated his survival to be less than 6 months.

A right-sided tubular MIS decompression at L1-2 was performed. Postoperatively his functional status improved from 2/5 to 4+/5 strength in his lower extremities, most

notably in his dorsal and plantar flexors. Postoperative imaging demonstrated decompression of involved area [Figure 5].

He maintained this functional increase and had significant decrease in radicular pain and sensory loss [Table 2], necessitating much less analgesics. The patient entered neuro-rehabilitation but succumbed to his disease 4 months later.

Case 3: Hepatocellular carcinoma

This 73-year-old male presented with a 1 month history of progressively worsening left leg weakness, numbness, and dysethesia. He had a 2-year history of metastatic hepatocellular carcinoma secondary to transfusion-acquired hepatitis C and a known metastatic

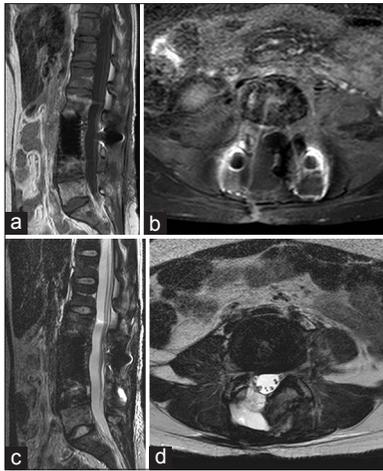


Figure 3: Postoperative T1-weighted (a) sagittal and (b) axial and T2-weighted (c) sagittal and (d) axial MRI reveal interval L4 level tumor resection and decompression of the nerve roots

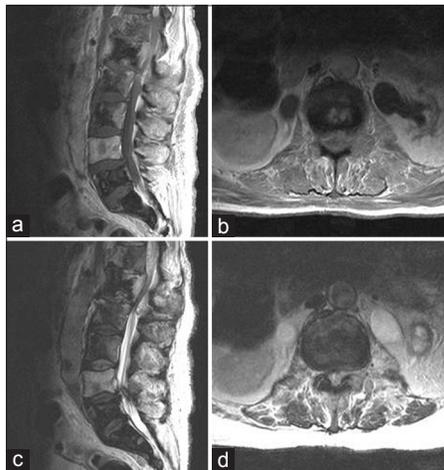


Figure 4: Preoperative (a) sagittal and (b) axial T1 and (c) sagittal and (d) axial T2 MRIs reveal diffuse lumbar metastatic disease, L1 vertebral expansivity causing near complete canal occlusion, and left-sided L1 and L2 foraminal impingement from an epidural mass

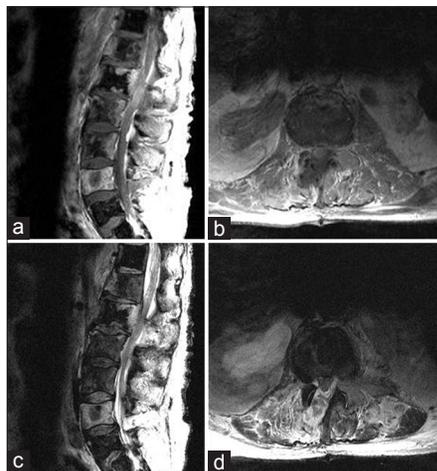


Figure 5: Postoperative T1-weighted (a) sagittal and (b) axial and T2-weighted (c) sagittal and (d) axial MRI reveal interval surgery at L1-L2 resulting in decompression of the spinal canal

lesion at L3-L4 for which he had already received radiation therapy. Oncology service predicted 6 months longevity.

Preoperative examination revealed 2/5 strength in the left hip and knee with radiculopathy. MRI showed numerous spinal metastases, confirming the presence of a large 5.5×4.8 cm enhancing paraspinal mass at L3-L4 level with mass effect. Although he was high cardiac risk (three-vessel coronary artery disease) and thrombocytopenic (platelet <50), he elected to undergo palliative debulking of the lumbar epidural tumor via left-sided L3-L4 MIS spinal decompression with L3-L4 laminectomy. Prior to incision, patient was given platelets to correct this thrombocytopenia. Intraoperatively, the tumor was found to encase the underlying nerve root.

After decompression, he experienced immediate improvement of his radiculopathy and improved lower extremity weakness, increasing to 3/5 left hip and knee strength. Postoperative troponins were within normal range.

Further clinical and radiographic assessments were not possible as the patient suffered a STEMI 2 weeks after surgical decompression (with do not resuscitate [DNR] order) and succumbed to cardiogenic shock [Table 2].

DISCUSSION

The goal of spinal tumor surgery is complete resection in order to achieve a cure. However, in the setting of metastatic disease with a cure unlikely, the goal of surgery becomes palliation. In our series, we showed that MIS decompression is a successful palliative therapy for MECC in patients with comorbidities, failed therapies, and significant systemic disease entailing a limited life expectancy and making them traditionally poor operative candidates. Through pre- and postoperative visual analogue scale (VAS) scores, opioid doses, and motor assessments, we show that our surgeries accomplished the goal of palliative treatment with excellent persisting functional outcomes and quality of life. Postoperatively, all three subjects had dramatically improved function and pain, which was maintained until the last long-term follow-up or ultimately death of our patients. Our follow-up was more than sufficient to demonstrate the lasting effect for these patients and was therefore not aimed at addressing long-term recurrence, something that would have little implication for patients of such limited life expectancy.

This success highlights an important point, that complete resection of tumor is not the goal nor would it be in the patient's best interest. For example, to completely address the local spinal pathology in our first patient, a corpectomy at the affected level with extension of corpectomy cage and pedicle screw fixation would be

needed. This would necessitate a highly morbid combined anterior and posterior surgical approach with months of recovery, leaving the patient incapacitated for the remainder of her life. Instead, our MIS approach allowed the patient to return home the same day and return to college studies within 1 week of surgery. As in this case, this cohort of patients would undoubtedly succumb to their systemic disease before a localized lesion would cause any recurrent issues.

We experienced one death due to myocardial infarction 2 weeks postoperatively in a patient with a history of metastatic pulmonary effusions and three-vessel coronary artery disease status post right anterior descending artery stenting. Preoperatively the patient received all necessary interventions. Postoperative troponins did not demonstrate any cardiac ischemia. Resuscitative interventions were not attempted due to a DNR order. The alternative treatment for patients in the cohort would have been medical management of the pain and neurological compromise, something shown respectively to be of minor benefit.

We propose that for patients receiving MIS spinal decompression as palliation for symptomatic MECC, patients should have severe enough disease to warrant surgical over medical management, have failed or are poor candidates for alternative modalities, have comorbidities preventing alternative therapies, or have a high systemic disease burden and thus short life expectancy. Since all three of our patients suffered significant neurological compromise with advanced systemic disease, and patients two and three had already received the maximum doses of radiation, we elected for MIS decompression. Our decision was further supported by a recent randomized trial by Patchell *et al.* showing surgical decompression to be superior to radiotherapy.^[18] The authors found that initial treatment with surgery followed by radiotherapy preserved the ability to ambulate and that 30% of patients regained the ability to walk even when radiation failed.^[18,21] Furthermore, radiotherapy should not be undertaken for MECC due to the delayed effect on tumor shrinkage.^[19] Pain relief from radiotherapy is similarly delayed versus the more pervasive immediate benefit of surgical approaches as demonstrated in our patients, something significant for patients with short life expectancy.^[5,7]

We have previously described the superiority of MIS techniques in addressing extradural and intradural tumors.^[14,15] In cadaveric models, we showed that the transspinous mini-open approach to resection of thoracolumbar intradural tumors via expandable tubular retractor was superior to standard open approaches with markedly less tissue disruption, especially in the obese patient. Incisions were up to three times smaller. We also showed that MIS techniques could be employed

effectively over the existing approaches for the removal of extradural lumbar foraminal tumors with decreased tissue disruption, blood loss, and hospitalization time in addition to improved American Spinal Injury Association (ASIA) and back pain VAS score with no increase in operative time.^[13,14] Lau *et al.* similarly showed the MIS technique to have significantly decreased operative time, better outcomes, and fewer complications.^[12] Furthermore, for patients with prior surgeries, the mini-open technique could be performed lateral to previous surgical planes and thus avoid scar tissue.^[14]

Here we utilized a tubular MIS approach to resect extradural metastatic tumors. The tubular approach further decreased the size of incision (1.8 cm) and the invasiveness of surgery.

Due to the poor systemic control of metastatic disease in these patients, the main goal of our surgery was not for complete resection, but for improvement in pain and possible neurologic function. From radiographic and clinical perspective, the extent of resection was adequate. In the cases presented, all had modest blood loss (average: 15 cc) and decompression was accomplished expeditiously (average intraoperative time: 67 min). Such operative profile is compatible with this approach in our cohort, who have high systemic disease burden with associated comorbidities and have often failed initial treatment.

Due to incomplete resection of tumors by this approach, there may be concerns for postoperative compressive hematoma, particularly in cases of vascular tumors. For vascular tumors, one may perform preoperative angiogram with embolization of feeding vessels. Intraoperative hemostasis is attained through both gel-foam with thrombin and electrocautery, while postoperative control is achieved through a subfascial drain and normalization of coagulation factors, exemplified by our third patient.

These promising preliminary results for this MIS approach as palliative therapy for MECC in our patient cohort would justify a larger prospective trial with more careful comparative analysis of treatment modalities and appropriate long-term follow-up.

We present three cases of MECC palliated by MIS decompression demonstrating immediate and substantial benefit through significant pain reduction and near full restoration of sensory and motor deficits. Our case series is unique in that we demonstrated that our treatment was an excellent therapy for patients with other comorbidities, failed therapies, and significant systemic disease making them unfavorable candidates for other treatment modalities. Furthermore, our follow-up was more than sufficient for these patients of limited life expectancy to demonstrate outstanding enduring functional outcomes and quality of life postoperatively.

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