Minimally Invasive Anterolateral Corpectomy for Spinal Tumors

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KEYWORDS

• Minimally invasive • Tumor • Retropleural • Transthoracic • Lateral • Corpectomy

KEY POINTS

- Thoracic tumors can be treated by a variety of different surgical approaches, both anterior and posterior, each of which is associated with morbidity and limitations that can lead to increased recovery time and rate of complications.
- Endoscopic (thoracoscopic) approaches that reduce approach-related morbidity but have a steep learning curve have been described.
- The mini-open anterolateral approach provides direct visualization of the ventral spine and neural elements without the morbidity associated with more traditional approaches.

INTRODUCTION

Surgical approaches for disorders of the thoracolumbar spine have traditionally included an anterior or posterior approach, or some combination of the two. The technique used generally depends on surgeon preference, lesion location, pathologic process, and affected level. Spine tumors are classified as extradural, intradural-extramedullary, or intramedullary. Most of these include benign intradural-extramedullary tumors that may grow to compress neural elements to cause symptoms. In the era of modern medicine, treatment options for primary or metastatic spine tumors include radiation, radiation plus chemotherapy, stereotactic radiosurgery, hormonal therapy, or surgical decompression followed by radiation.[1] However, vertebral tumors often require surgical treatment to obtain tissue for diagnosis, decompress neural elements, control pain, improve quality of life, alleviate symptoms, and address spinal instability pursuant to encroachment of the osseous anatomy. Radiation and chemotherapy alone are options for patients either with palliation in mind, or with newly diagnosed disease that shows no evidence of neurologic compromise or spinal instability. When surgery is indicated, the surgeon must consider histologic type of the tumor, prior treatments, tumor location (in the global spinal picture but also within the vertebral body or spinal column), and the patient's life expectancy.

More than 90% of spinal column tumors in the United States are metastatic, most commonly from breast, lung, and prostate, while 30% to 70% of patients with cancer have vertebral involvement.[2–6] The thoracic spine is most commonly involved with neoplasm (70%), followed by lumbar (20%) and cervical (10%), while multiple levels are affected in up to one-third of cases.[2,5] Approximately half of all spinal tumors are extradural, 35% to 40% are intradural-extramedullary, and the remaining 5% to 10% are intramedullary.[7,8]

Disclosure: J.S. Uribe is a consultant for NuVasive, Inc and Orthofix.
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Neurosurg Clin N Am 25 (2014) 317–325
http://dx.doi.org/10.1016/j.nec.2013.12.009
1042-3680/14/$ – see front matter © 2014 Elsevier Inc. All rights reserved.

In comparison with metastatic disease, primary osseous neoplasms are uncommon and are classified as benign or malignant. Such tumors can include osteoid osteoma, osteoblastoma, osteochondroma, aneurysmal bone cyst, eosinophilic granuloma, and cavernous hemangioma among the benign lesions; malignant pathology can include giant cell tumor, plasma cell tumor, lymphoma, osteosarcoma, chondrosarcoma, chordoma, and Ewing sarcoma.[9] Patients most commonly present to their physician with complaints of progressive back or neck pain, although weakness may be a presenting symptom in cases where neural elements are compressed. Treatment options vary based on complete or incomplete deficits. One of the greatest stimuli for the advent of minimally invasive surgical (MIS) approaches is the reduction of morbidity through traditional surgery. This aspect is especially evident in the thoracic spine, where traditional anterior and posterior approaches are associated with significant morbidity. This article describes MIS anterolateral corpectomy in the treatment of spinal tumors, and reviews the current literature.

ANTERIOR-BASED APPROACHES

Traditional surgical approaches for the treatment of spinal tumors include anterior-based and posterior-based approaches, or a combination of both.[10–14] Anterior transthoracic approaches have long been established in the management of many pathologic conditions of the anterior thoracic spine. The anterior approach offers easier access to the ventral aspect of the spine and allows decompression without the associated risks of spinal cord or nerve root manipulation,[13–15] but often requires a thoracotomy. There is significant morbidity associated with a thoracotomy, including pain from a large incision and increased muscle dissection, prolonged chest drainage, pulmonary complications such as contusions, atelectasis, effusions, hemothorax and chylothorax, and an extended hospital stay.[16] Major complications with use of the thoracotomy approach have been shown in as many as 79% of patients.[17,18] A lateral retropleural approach aims to be less destructive to the surrounding tissues by not compromising the pleura and using serial dilation as a course to the abnormality. In a more anterior approach the abnormality is encountered first, and the neural elements cannot be visualized until ventral decompression is completed. However, in the lateral retropleural approach the surgeon is able to visualize the thecal sac during the approach to the lesion, affording access to both the thecal sac and the abnormality at the same time. Occasionally the anterior longitudinal ligament may need to be resected, potentially leading to destabilization.

To mitigate some of the morbidity of the anterior approaches, MIS thoracoscopic techniques were developed and have proved to be effective, but challenging, in terms of learning curve and application. These approaches have been adopted as a means of gaining anterior access to the thoracic spine without requiring large incisions or rib resection.[19–24] Complications, including transient intercostal neuralgia, postoperative atelectasis, pneumothorax and hemothorax, and pleural effusion, are considered to occur with a lower incidence than for open thoracotomies, with a reported range of 14.1% to 29.4%.[23] The lateral retropleural MIS approach to the thoracolumbar spine is considered a variant of the thoracotomy, but combines many of the positive attributes of both anterolateral transthoracic approaches and the lateral extracavitary approach. It affords the surgeon the ability to remain outside the pleura while achieving a ventral decompression of the dural sac, which is especially important with centrally located abnormalities.

POSTERIOR-BASED APPROACHES

Indications for posterior approaches in spine oncologic surgery, which were first introduced by Capener[25] and later modified by Larson and colleagues,[10] include tumors involving the posterior elements or extending into the anterior column. Resection of the posterior elements, epidural tumor, and involved vertebral bodies can be performed through the transpedicular, costotransversectomy, or lateral extracavitary approach, depending on the location of the tumor and how far lateral and anterior the surgeon wishes to be. In general, posterior approaches to perform a corpectomy for tumor resection require the surgeon to visualize and occasionally manipulate the neural elements before encountering the abnormality.[26] These approaches have the advantage of being familiar to most neurosurgeons, allowing for vertebral reconstruction and simultaneous posterior spinal instrumentation and fixation, and are especially suitable for upper thoracic lesions and multilevel disease, or in the setting of multiple medical comorbidities.[27] However, visualization of the dural elements is limited to an oblique view. Extensive muscle dissection is required, and may be associated with copious blood loss. Sectioning of nerve roots may be required for placement of an interbody device, and its size or footprint is limited secondary to constraints imposed by a posterior approach, potentially leading to an increased rate of subsidence or pseudarthrosis.

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