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Posterior surgical approaches and outcomes in metastatic spine-disease

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Metastatic spinal cord compression is a dreaded and, unfortunately, common complication of advanced malignancy. Each year, approximately 40% (200,000) of cancer patients develop vertebral metastases, and 10% to 20% (25,000) develop spinal cord compression [1–3]. The usual presenting symptom of bony metastases is pain, which usually precedes neurologic symptoms by 4 to 7 weeks [3,4]. In patients with known cancer and new-onset back pain, 50% have vertebral metastases [5,6]. Unfortunately, 10% of patients with spinal disease have no history of cancer [3]. The primary cancer in 50% or more of patients is breast, lung, prostate, or renal [7,8]. The thoracic spine is most commonly affected (70%), followed by the lumbar (20%) and cervical spine (10%) [2,7,9]. Multiple lesions at noncontiguous levels occur in 10% to 40% of cases [2,7,9,10]. Survival is primarily dependent on the primary histology, the biologic aggressiveness of the cancer (grade), and the extent and control of systemic disease. Treatment is largely viewed as palliative; consequently, the goal should be to provide maximum benefit in the quality of the patient's remaining life with as little harm caused by the intervention as possible.

For many years, surgery was limited to posterior decompressive laminectomy. As discussed in more detail later, decompressive laminectomy did not lead to better results alone or combined with adjuvant radiation compared with radiation alone. In most patients, the metastasis affects the vertebral body first and then spreads to the posterior elements, such as the pedicle, facets, and lamina. Rarely is disease isolated to the lamina and spinous process, an ideal scenario in which to use a laminectomy. Thus, in most patients, although the laminectomy enlarged their spinal canal, the site of spinal cord compression (ie, ventral to the cord) was left unaddressed. Starting in the mid 1980s, surgeons recognized this deficiency and began to perform vertebral body resections through an anterior approach, such as a thoracotomy [11,12]. These preliminary results seemed to indicate improved outcomes compared with laminectomy and radiotherapy. Since that time, many similar cohort studies have been published that continue to demonstrate a superior ability to maintain ("success") and regain ("rescue") ambulatory function in addition to improving sphincter function and pain control [13]. Recently, Patchell et al [14] presented the results of their randomized trial supporting surgery followed by adjuvant radiotherapy as the primary treatment for patients that met their study entry criteria.

The goals of surgery today are to decompress the spinal cord circumferentially, reconstruct the anatomic columns, and then immediately stabilize

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the spine with the use of a wide variety of internal fixation devices. In planning the surgical approach, the anatomic extent of the lesion must be understood in three dimensions and the stabilization and reconstruction needs must be anticipated. The approach and extent of surgery depend on two primary anatomic factors: the location within the spinal column and the extent of disease within the individual vertebrae. For example, McLain and Weinstein [15] divided the vertebrae into four zones: I through IV (Table 1). Each zone is also designated with a modifier, A through C, for intraosseous, extraosseous, and distant tumor spread, respectively. According to the authors, lesions isolated to zone I or II are best approached posteriorly or posterolaterally. Anterior approaches should be used for zone III lesions. Zone IV lesions are the most difficult to resect. They usually require a combined approach. The goals of surgery today can be achieved by anterior, posterior, and combined approaches. This article focuses on posterior approaches used in the cancerous spine (with an emphasis on the thoracolumbar spine) as well as their indications and published outcomes. These approaches are classified as direct posterior (laminectomy with or without internal fixation) and posterolateral (transpedicular, costotransversectomy, and lateral extracavitary/parascapular).

Direct posterior trajectory

Posterior decompressive laminectomy

The standard posterior decompressive laminectomy has several advantages. It is a standard surgical approach well known to all neurosurgeons; it can be performed quickly with minimal intraoperative morbidity throughout the spine (a feature of particular importance in a disease in which the rapidity of neural decompression is crucial); it does not require the placement of internal fixation devices; and it provides excellent exposure of the posterior elements, namely, the facets, lamina, and spinous process (Fig. 1). The posterior decompressive laminectomy should only be used in purely posterior disease, however. It does not directly expose the anterior vertebral elements, and the spinal cord is at high risk if it is manipulated in an attempt to reach more anterior structures. This latter point is especially relevant in the middle to lower thoracic area, where the vascular supply is already less robust. Furthermore, this approach may destabilize a spine that is already affected by disease anteriorly, leading to deformity (kyphosis), pain, and increased spinal cord compression.

Numerous studies have shown that the laminectomy is really no more effective at relieving pain and preserving or regaining neural function than radiotherapy [8,9,16–22]. Sorensen et al [21] followed 345 patients, 149 of whom received radiation only, 105 a laminectomy alone, and 91 a laminectomy followed postoperative radiation. When controlled for the patients' pretreatment ambulatory status, there was no difference in outcome between the three treatment modalities. This same conclusion was found in another large cohort study of 398 cases by Bach et al [8]. More recently, Schoeggl et al [23] presented their results in a more select group of 84 patients who had predominant infiltration of the dorsal epidural

Table 1
Division of vertebrae by McLain and Weinstein

Zone	Description
I	Spinous process to the pars interarticularis and the inferior facets
II	Superior articular facet, the transverse process, and the pedicle from the level of the pars to its junction with the vertebral body
III	Anterior 3/4ths of the vertebral body
IV	Posterior 1/4th of the body

From McLain RF, Weinstein JN. Tumors of the spine. In: Herkowitz HN, Garfin SR, Balderston RA, editors. Rothman-Simeone: the spine, vol. 2. Philadelphia: WB Saunders; 1999. p. 1171–206; with permission.

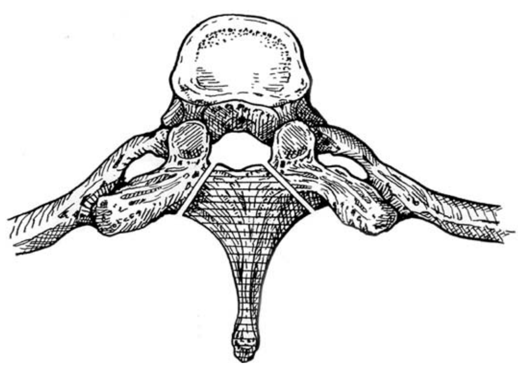

Fig. 1. Diagram showing the laminectomy. The shaded area represents the excision of the spinous process and lamina. The laminectomy effectively enlarges the space for the spinal cord but does not address disease that may reside elsewhere in the vertebrae.

region or who could not be operated on via an anterior approach. Before surgery, 80% were nonambulatory and 56% had sphincter dysfunction. Overall, mobility increased to 45% immediately after surgery but decreased to 33% and 25% at 2- and 4-month follow-ups, respectively. Postoperative sphincter dysfunction decreased to 38% but then increased to 46% at 2 months and 51% at 4 months. The most important determinant of postoperative neurologic function was the patient's preoperative status. None of the plegic patients had any improvement, and none of the patients who needed catheterization before surgery improved. Many of them reacquired pain on follow-up, however. The authors had an intraoperative complication rate of 4.7% (three durotomies and one laminectomy at the wrong level) and a postoperative complication rate of 4.7% (four superficial wound infections and one epidural abscess).

Posterior decompressive laminectomy combined with internal fixation

Recognizing that instability may be one of the reasons for the poor results with the decompressive laminectomy, a number of surgeons have performed wide decompressions followed by stabilization with internal fixation devices (eg, pedicle screws), with improved outcomes. Olerud and Jonsson [24] state that compression of the spinal cord by tumor located ventrally seldom requires a direct resection from the front. Unlike many of their North American counterparts, they believe that "...it is usually possible to obtain an acceptable decompression merely by realigning the spine and distracting over the segment, thus reducing the vertebra out of the spinal canal." Such a decompression has also been called "indirect ligamentotaxis-type decompression" [25]. After reduction, the spine is stabilized with a neutralizing fixation device. The authors also believe that there is "...no simple technique available where the defective anterior column can be reconstructed from a posterior approach."

Rompe et al [26] applied this philosophy in 106 patients with a total of 259 cancerous vertebrae. Of the 33 patients who were nonambulatory, 20 regained the ability to walk, and 18 of the 56 patients with a preoperative deficit had a full recovery. At 1 year, 51 of the 53 surviving patients were still able to walk. Pain was also significantly improved. Complications included 6 patients with transient neurologic worsening, 4 patients with wound complications, and 6 patients with reoperation to extend the stabilization construct. Bauer [27] operated on 69 patients, 58 of whom had a deficit before surgery. After surgery, 44 of them had a complete neurologic recovery and 18 of the 26 nonambulants regained the ability to walk. Ambulatory function persisted for most patients until their death from systemic disease. Sherman and Waddell [28] conducted a review of their experience with posterior decompression in 134 patients treated between 1975 and 1982. The first 111 patients underwent a simple decompressive laminectomy, whereas the subsequent 23 patients had supplemental stabilization, which included Harrington rods, methylmethacrylate, or rib strut grafts. The two groups were similar in terms of the preoperative pain, and neurologic and sphincter function status. At 6 months after surgery, the group with internal fixation had better ambulatory status (92% versus 57%), sphincter function (63% versus 31%), and pain control (55% versus 32%) and less recurrent neurologic dysfunction. Postoperative radiotherapy did not improve the results in either group. The authors concluded that iatrogenic instability is created in all patients who undergo only a decompressive laminectomy and that internal fixation thus provides better results secondary to restoration of stability or prevention of late instability. These and other similar results indicate that this is a reasonable surgical option in patients who cannot tolerate a more direct extensive approach or who have multilevel disease [25,29,30].

Posterolateral trajectories

Posterolateral approaches allow visualization of the anterolateral elements of the spine and use the same principles as skull base surgery: resection of osseus structures to provide a wider operative corridor, improved line of sight, and less retraction on neural structures. These approaches are used most commonly in the thoracic and lumbar spine. All the goals of surgery—decompression, reconstruction, and stabilization—can be achieved without the increased morbidity of anterior approaches. With increasing bone removal (ie, from the transpedicular approach to the costotransversectomy, and finally to the most extensive approach, the lateral extracavitary/lateral parascapular), the operative trajectory becomes more lateral to visualize the affected vertebrae better.

Transpedicular approach and other modifications

For situations in which tumor extends from the dorsal elements into the ventral elements via the pedicles, or when disease is isolated to the ventral elements, a facetectomy with pediculectomy can be performed. This may be performed unilaterally or bilaterally, depending on the extent of disease (Fig. 2). It does provide a posterolateral route, albeit with somewhat limited exposure, to the vertebral body. Bridwell et al [31] performed anterior spinal cord decompression in 25 patients with metastatic disease by a uni- or bilateral pediculectomy (with or without a laminectomy), followed by instrumentation at least one level above and below the diseased level. Pain was relieved to some degree in 19 of the 25 patients, and 6 patients improved by at least one Frankel grade. One patient suffered hardware failure that required revision, and 3 patients subsequently underwent a transthoracic approach for persistent spinal cord compression. Weller and Rossitch [32] reported on 8 patients, 5 of whom had preoperative motor deficits. No stabilization was required. All 5 patients showed improvement and were ambulatory. There were no complications or perioperative deaths. Shaw et al [33] used a similar approach successfully in 6 patients in terms of pain control and ambulatory function. Three patients suffered serious medical complications, however, including one perioperative death.

Akeyson and McCutcheon [34] performed a complete vertebrectomy ("spondylectomy") via a single-stage, bilateral, extended transpedicular approach in 25 patients. They first performed a laminectomy, followed by removal of the superior and inferior facets and costovertebral joints of the affected levels. In this approach, the pedicles are removed if they are filled with tumor or cored out if not. Through the remnant of the pedicles, tumor within the vertebral body is removed, leaving a thin rim of bone anteriorly for placement of methylmethacrylate. Complete circumferential decompression of the thecal sac is thus achieved. If multiple levels are decompressed, the intervening disks are removed and Steinmann pins are placed with methylmethacrylate. Akeyson and McCutcheon [34] achieved stabilization using a Luque rectangle secured with sublaminar wires. Of the 18 patients with preoperative neurologic deficit, 10 showed improvement. There was one recurrence. The single most common complication was a cerebrospinal fluid (CSF) leak in 12 patients, and the most serious complication was

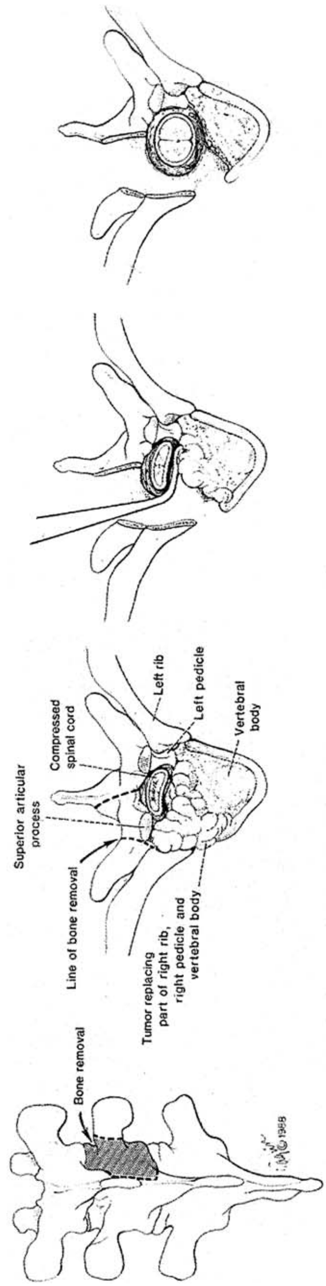

Fig. 2. A unilateral transpedicular approach to resect disease located within the vertebral body and pedicle. Although access to the vertebral body is still limited, many surgeons have successfully used this technique to achieve circumferential spinal cord decompression. This often requires a bilateral transpedicular approach. Reconstruction of the anterior and posterior elements can be performed. (*From* Shaw B, Mansfield FL, Borges LF. One-stage posterolateral decompression and stabilization for primary and metastatic vertebral tumors in the thoracic and lumbar spine. J Neurosurg 1989;70:405–10; with permission.)

migration of the methylmethacrylate graft or pins in 4 patients. Their overall complication rate was 50%. Mühlbauer et al [35] performed a similar procedure in 17 patients. They had similar postoperative results, and their most frequent complication was a CSF leak as well. Both groups strongly advocated meticulous removal of tumor from around the thecal sac to prevent recurrence, including removal of the posterior longitudinal ligament (PLL).

This posterolateral approach offers several advantages over an anterior thoracic or thoracoabdominal approach, including earlier identification of the spinal canal, the ability to address disease in the posterior elements, and the ability to provide more rigid longer segment fixation [36,37]. Furthermore, imbalances in the sagittal plane (listhesis), coronal plane (scoliosis), and axial plane (rotation) can be more easily corrected with the posterior approach.

Bilsky et al [37] used a posterolateral transpedicular approach in 25 patients similar to the one described previously. Vertebral body resection was limited to the infiltrated bone, however, generally maintaining the intact cortical bone, a technique called intralesional decompression. Once the thecal sac was decompressed, the authors reconstructed the spine using methylmethacrylate with Steinmann pins anteriorly and a claw/compression construct posteriorly. All patients with severe or moderate pain before surgery improved, and no patients experienced worse pain after surgery. Before surgery, 3 patients had an American Spinal Injury Association impairment grade of C, 6 had a grade of D, and 16 had a grade of E. After surgery, 20 had a grade of E, 2 had a grade of D, and 1 patient scored in each of the remaining categories. Two patients had worsened neurologically after surgery, 2 died within 30 days of surgery, and 2 suffered a local recurrence. The authors reported no CSF leaks or hardware complications.

Costotransversectomy

The costotransversectomy was first used by Haidenhaim and described by Menard [38] in 1894 for the drainage of tuberculous paraspinal abscesses in Pott's disease. The costotransversectomy approach provides access to the posterior and lateral aspects of the vertebrae, usually through a midline or paramedian incision. It extends the exposure provided by the pediculectomy by resecting the transverse process, the medial portion (5–7 cm) of the rib and rib head, and the costotransverse and costovertebral ligaments (Fig. 3). The initial description involved a transverse incision over the rib at the apex of kyphosis. There have been numerous "modified" costotransversectomies reported in the literature [36,39–44]. The advantages of this procedure are that (1) it can be performed from T2 to L3; (2) it does not require excessive paraspinal muscle dissection; (3) it may be combined with a laminectomy; (4) it provides enhanced access to the posterolateral aspect of the vertebral body, allowing spinal cord decompression; (5) it provides an alternative for those patients who would otherwise be unable to tolerate a formal thoracotomy (because of preexisting pulmonary, mediastinal, or retroperitoneal disease); (6) it may be used in patients with disease in two or more adjacent levels or involvement at two discontinuous levels; and (7) it allows the placement of internal fixation devices anteriorly and posteriorly. The main disadvantage of the costotransversectomy, like the transpedicular approach, is that access to the vertebral body is still somewhat limited; thus, removal of tumor and restoration of the anterior and middle columns are challenging. Other disadvantages are that the parietal pleura may be inadvertently breached, requiring a chest tube, and that nerve roots are at risk for injury and can be the source of CSF fistulas when they are sacrificed. Furthermore, if there is a significant amount of intrathoracic or retroperitoneal tumor, a more direct approach would be better.

Cybulski et al [43] used this approach in 15 patients, 10 of whom required supplemental posterior fixation. For lesions located between

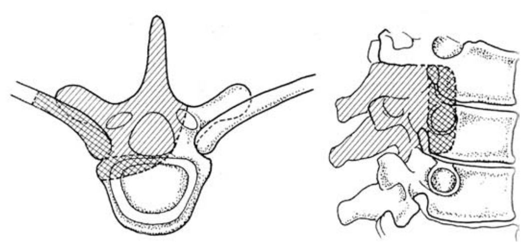

Fig. 3. The modified costotransversectomy approach. The shaded area indicates removal of the lamina, facet, transverse process, and pedicle. Additional bone removal from the rib head and vertebral body (*crossed area*) improves exposure of the spinal cord. (*From* Overby MC, Rothman AS. Anterolateral decompression for metastatic epidural spinal cord tumors. J Neurosurg 1985;62:344–8; with permission.)

T1 and T5, a lateral decubitus position was used, and for lesions from T6 to T12, a prone position was used. A curvilinear incision centered off the midline over the costotransverse process at the level of the pathologic findings was performed, followed by soft tissue dissection to expose the proximal 6 to 8 cm of the rib and rib head, the costotransverse joint, and the pedicle, which were then removed. Adequate anterior decompression was achieved in all patients. All patients who were ambulatory remained so after surgery, and pain was improved in 75% of patients. Overby and Rothman [40] reported on 12 patients, only 1 of whom was ambulatory. All patients were placed in a semiflexed 45° prone oblique position to allow the intrathoracic contents to fall away from the spinal axis by gravity, followed by a midline incision and a subperiosteal dissection. Only 1 patient required placement of fixation devices. After surgery, 8 patients were ambulatory and 10 regained functional bladder control.

Cahill and Kumar [36] also used this approach successfully in nine patients with single vertebral metastatic disease between T2 and L3. Each patient had one or more of the following factors: noncontiguous and incidental spinal metastatic disease; visceral involvement with metastatic deposits in the lung, liver, peritoneum, or adrenal gland; extensive bony metastatic disease; and advanced age. Also, two of the patients had previously undergone a thoracotomy and lung resection. The authors exposed the posterior elements in a standard subperiosteal fashion laterally to the transverse processes and ribs. After a laminectomy, removal of the facets, transverse processes, pedicles, and proximal 2 to 4 cm of the rib at the involved segment and the adjacent caudal segment were performed. If disease was purely unilateral, bone removal was limited to the side of the disease. The intercostal nerves were sacrificed. Before removing tumor in the vertebral body, discectomies were done above and below the disease level to establish resection margins. The corpectomy was then performed in a piecemeal fashion removing all tumor, sometimes creating a total vertebrectomy if necessary. Before vertebral body resection, the segmental vessels and sympathetic chains were ligated and cut. Vertebral body reconstruction was achieved with methylmethacrylate and Steinmann pins, taking care not to allow the methylmethacrylate to touch the dura during the exothermic reaction as it hardens. Posterior reconstruction was usually performed using short segmental pedicle screw and rod constructs. After surgery, all patients, except for one who was paraplegic before surgery, remained ambulatory and pain-free until days before they died [36]. Three patients with preoperative weakness fully recovered. There were no perioperative deaths, neurologic injuries, or wound complications. Spinal alignment and stability were maintained in all but one patient. The goals of the surgery, as stated by the authors, were "...to provide immediate postoperative ambulation, brief hospital downtime, and spinal stabilization for the remainder of their brief lives." They believe that this approach should only be used in patients with extensive bony disease, noncontiguous spinal involvement, visceral metastases, or other contraindications to transcavitary procedures as well as in extremely elderly patients.

McLain [45,46] and McLain and Lieberman [47,48] have published several reports about their experiences using 30° and 70° endoscopes to enhance tumor resection with the costotransversectomy (Fig. 4). After the anterior portion of the tumor is debulked under direct visualization, forming a cavity, the 30° scope is used to allow direct examination of the interval between the PLL and the posterior cortex. The remaining diseased vertebral body is removed up to the contralateral pedicle. The 70° scope is then used to visualize the PLL and dura from below, identifying any residual spinal cord compression. After the dissection is complete, a strut graft is placed between the vertebral bodies with or without supplemental posterior fixation. McLain [46] used this technique in nine patients, with all patients returning to or maintaining normal strength, sensation, and sphincter function.

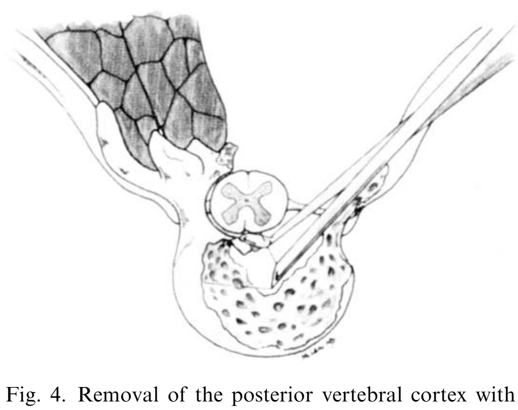

Fig. 4. Removal of the posterior vertebral cortex with the aid of an endoscope. (*From* McLain RF. Endoscopically assisted decompression for metastatic thoracic neoplasms. Spine 1998;23:1130–5; with permission.)

Lateral extracavitary/lateral parascapular approach

Like the costotransversectomy, the lateral extracavitary approach was developed for the management of tuberculous spondylitis. Capener [49] introduced the approach, originally called the lateral rhachotomy, in 1954, but Larson and his colleagues [50] popularized it in later years. As Capener [49] stated, it is "...merely a further stage in surgery based upon Ménard's costo-transversectomy." The costotransversectomy, Capener states, was designed to decompress the vertebral lesion (ie, drain the paraspinal abscess), whereas the lateral extracavitary approach deals directly with the actual cause of the cord compression. For metastatic spinal disease, the costotransversectomy and lateral extracavitary approaches achieve the same goals: circumferential spinal cord decompression, reconstruction, and stabilization. The lateral extracavitary approach achieves this by a wider and more lateral exposure of the vertebral body at the expense of a more extensive soft tissue and osseous dissection, however (Fig. 5). Given the palliative nature of surgery for metastatic spinal disease, the lateral extracavitary approach is not as widely used as the costotransversectomy.

In Capener's original description [49], the patient was positioned prone and a curvilinear incision was used, with the apex of the incision located 3 inches from midline and positioned at the top of the kyphos. The paraspinal musculature was sharply divided and reflected to gain access to the bony structures, namely, the rib(s), transverse process, and pedicle, which were then removed. This left an unobstructed view of the lateral aspect of the vertebral body and thecal sac. Since that time, there have been various modifications namely by Larson et al [50] and Benzel [51]. For details on the operative technique of the lateral extracavitary approach in the middle to lower thoracic and lumbar spine, we refer the reader to the article by Schmidt et al in this volume of the *Neurosurgery Clinics of North America*.

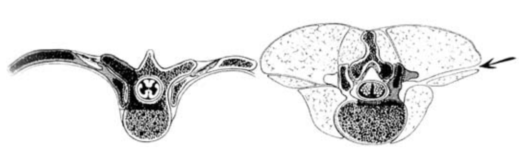

Fig. 5. The lateral extracavitary approach in the thoracic (*left*) and lumbar (*right*) spine. The shaded areas show the extent of bone removal. (*From* Larson SJ, Holst RA, Hemmy DC, Sances A, Jr. Lateral extracavitary approach to traumatic lesions of the thoracic and lumbar spine. J Neurosurg 1976;45:628–37; with permission.)

Unfortunately, much of clinical literature on the lateral extracavitary approach has comprised reports on trauma patients. McCormick [52] used this approach in 12 patients with complex dumbbell and paraspinal tumors involving the thoracic and lumbar spine; only 1 patient had metastatic disease (renal cell). Gross total removal was achieved in 10 patients, and a wide radical marginal en bloc resection was performed in 3 patients with primary bone neoplasms. Apart from

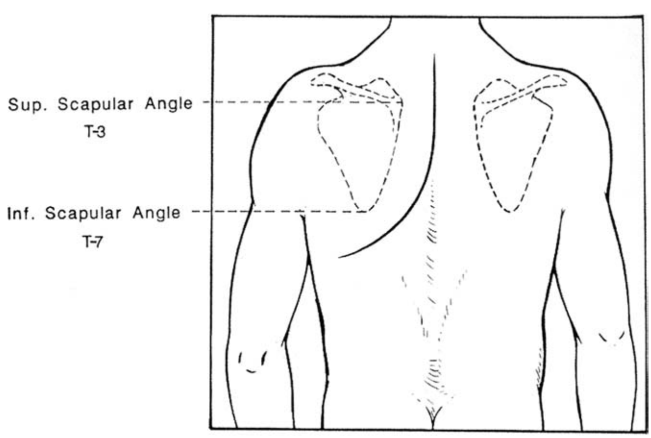

Fig. 6. Hockey stick incision used for the lateral parascapular approach. (*From* Fessler RG, Dietze Jr DD, Millan MM, Peace D. Lateral parascapular extrapleural approach to the upper thoracic spine. J Neurosurg 1991;75:349–55; with permission.)

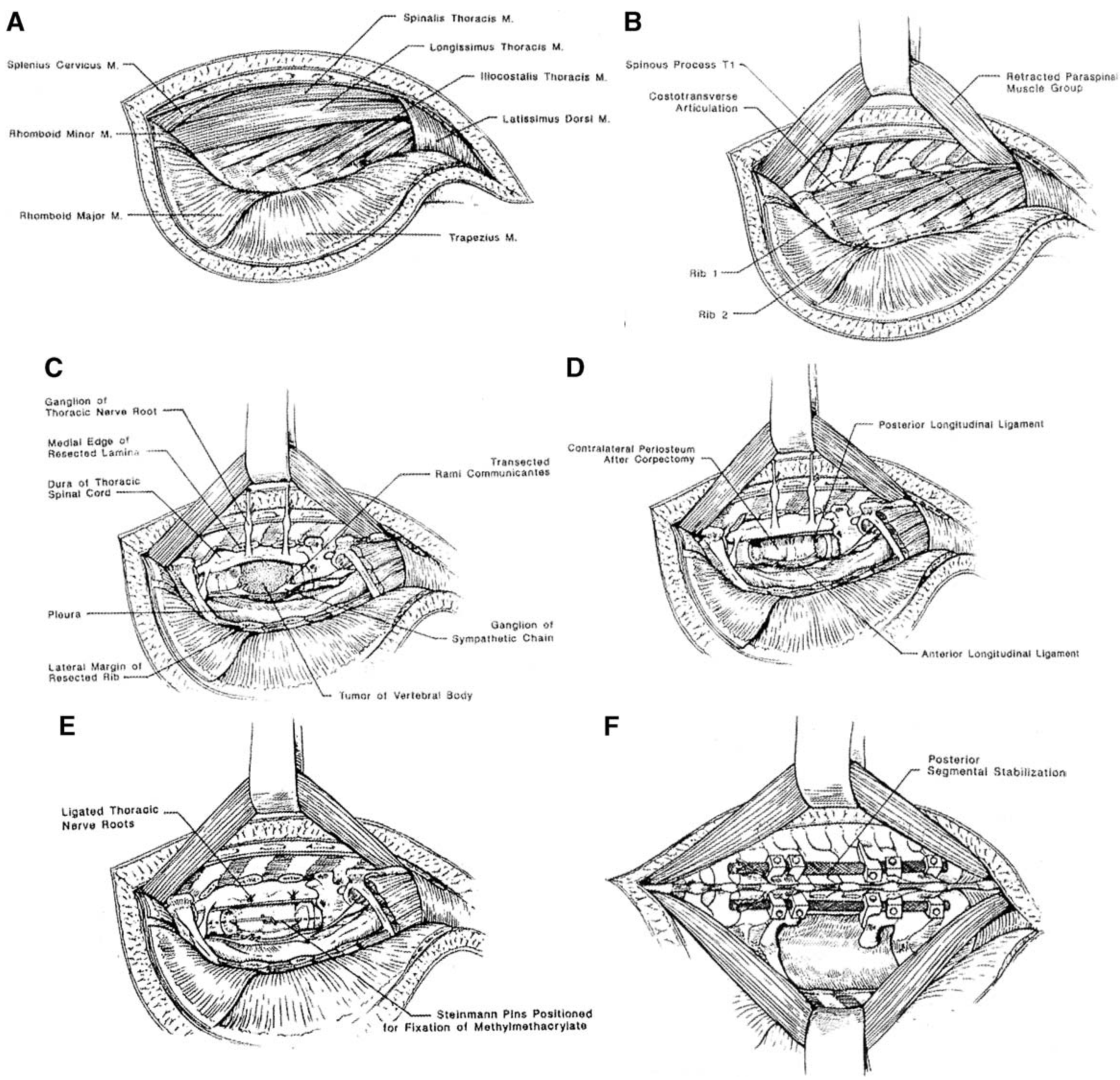

Fig. 7. The lateral parascapular approach. The orientation is such that rostral is to the left and caudal is to the right. (*A*) A myofascial cutaneous flap is turned containing skin, subcutaneous fascia, and trapezius and rhomboid muscles. This allows the medial border of the scapula to fall away laterally. (*B*) Dorsal and medial retraction of the paraspinal muscle mass. (*C*) Exposure of the ventral pathologic findings at T2 to T3 after removal of the second, third, and fourth ribs, along with their respective articulations, and the lamina, facets, transverse processes, and pedicles of each level. Collapse of the ipsilateral lung with single lung ventilation facilitates exposure. (*D*) Removal of the offending ventral mass. The most posterior aspect of the vertebral body is removed last to protect the spinal cord. (*E*) Vertebral body reconstruction using Steinmann pins and methylmethacrylate. (*F*) Posterior segmental instrumentation seen from a dorsal viewpoint. (*From* Fessler RG, Dietze Jr DD, Millan MM, Peace D. Lateral parascapular extrapleural approach to the upper thoracic spine. J Neurosurg 1991;75:349–55; with permission.)

2 patients requiring temporary chest tubes for pleural tears, there were no significant operative or postoperative complications. Resnick and Benzel [53] published their complications using the lateral extracavitary approach in 33 trauma patients. Eighteen patients suffered complications, with the most common being a hemothorax or pleural effusion requiring a tube thoracostomy. Other complications included pneumonia (7 patients), wound infections (4 patients), intraoperative CSF leaks (2 patients), incisional hernias (2 patients), and malpositioned hardware (1 patient).

The lateral parascapular extrapleural approach described by Fessler et al [54] modifies the lateral extracavitary approach to the upper thoracic spine by mobilizing the trapezius and rhomboid muscles to permit lateral retraction of the scapula for enhanced exposure. A similar hockey stick incision is used (Fig. 6). The trapezius and rhomboids are dissected off the spinous process and, along with the skin, reflected laterally as a musculocutaneous flap (Fig. 7A). There is a plane of loose areolar tissue between these muscles and the deeper paraspinous muscle groups that allows easy blunt dissection. The interspinous and supraspinous ligaments are kept intact. The medial border of the scapula is released with mobilization of the trapezius and rhomboids, allowing excellent exposure of the ribs and dorsal vertebral elements. The inferior fibers of the trapezius must be cut; thus, a cuff is left to facilitate reapproximation during closure. Care must be used not to injure the superior fibers of the latissimus dorsi when the inferior fibers of the trapezius are sectioned. The paraspinal musculature is dissected off the underlying osseous structures in a subperiosteal fashion and retracted dorsally and medially over the spinous processes (Fig. 7B). The thoracic cage is opened by resecting the rib at the level of the pathologic findings and one to two ribs below (see Fig. 7B). The rest of the operation proceeds as described by Benzel (Fig. 7C–F) [51]. This approach was used in four patients with metastatic disease of the upper thoracic spine and progressive neurologic decline [54]. The major postoperative complication was pulmonary, with all patients exhibiting an effusion, although only one patient was hypoxic and one patient died of fulminant pneumonia. Other complications included wound dehiscence and progressive kyphosis in one patient who required reoperation. O'Reilly et al [55] used this approach to resect a T1 dumbbell neurofibroma.

Summary

Spinal cord compression represents a major cause of morbidity and suffering in cancer patients. Surgery should be considered a form of primary therapy in many of these patients. The goals of surgery and the approach used are functions of a number of variables, including the surgeon's preference, the location of disease within the spine (cervical, thoracic, or lumbar), the extent of disease within each vertebra, the number of levels affected, and the patient's medical health and overall prognosis. Currently, the goals of any major debulking surgery are to decompress the spinal cord, prevent local recurrence, reconstruct the spine, and provide immediate stabilization with the use of fixation devices. Posterior approaches, starting with the decompressive laminectomy, have traditionally been the most common surgical procedures for metastatic spine disease. The laminectomy should only be used for disease isolated to the dorsal spine without evidence of concomitant instability. A laminectomy combined with instrumentation has been shown to provide superior results but should be reserved for those patients who cannot tolerate or would not benefit from more aggressive surgery. Various posterolateral approaches have been devised to access more ventrally placed lesions. These include the transpedicular approach, the costotransversectomy, and the lateral extracavitary/parascapular approach. Each of these allows adequate spinal cord decompression anteriorly and posteriorly and the ability to reconstruct and stabilize with acceptable perioperative risk. It must be remembered that surgery for this disease is almost always palliative. Thus, surgery should be a means to maximize the patient's quality of life while minimizing the risk of suffering surgical complications.

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