One-stage posterolateral decompression and stabilization for primary and metastatic vertebral tumors in the thoracic and lumbar spine

Brian Shaw, M.D., Frederick L. Mansfield, M.D., and Lawrence Borges, M.D.
Orthopedic and Neurosurgical Services, Massachusetts General Hospital, Boston, Massachusetts

During the past decade, anterior approaches to the spine have been shown to be much more effective than laminectomy for the relief of pain and neurological deficits due to vertebral metastases. Laminectomy has failed because it does not allow adequate decompression of epidural lesions anterior to the thecal sac. In an effort to combine the advantages of the posterior approach with an adequate decompression, a one-stage posterolateral decompression-stabilization procedure was performed on nine patients with thoracolumbar spine tumors. The approach has been used for decompression and stabilization after thoracolumbar burst fractures. Marked lasting improvement was seen in all six patients with preoperative neurological deficits and in four patients with severe back pain and/or radiculopathy. Three nonambulators and two marginal ambulators could walk postoperatively without assistance. Of five patients who were working preoperatively, four returned full-time to their prior occupations. Three patients had serious complications, including one early postoperative death. No patient deteriorated neurologically due to the procedure. Although the series is small, it demonstrates that adequate one-stage decompression-stabilization of spinal epidural lesions is possible via the posterolateral approach and should be considered in certain cases as an alternative to the anterior approach.

Key Words • spinal neoplasm • metastatic tumor • spine surgery • spinal stabilization • surgical technique
tential problems of the anterior approach. The surgical technique is the same as described by Erickson, et al., for use in treating thoracolumbar fractures.

Summary of Cases

Patient Population

Over the past 3 years, a posterolateral decompression-stabilization procedure has been performed on nine patients with primary or metastatic vertebral tumors at the Massachusetts General Hospital. Indications for surgery included intractable back pain, radiculopathy, progressive thoracic myelopathy, and cauda equina syndrome. Patients were evaluated preoperatively by history, physical examination, plain films, computerized axial tomography (CT), and, in cases of epidural compression, either magnetic resonance imaging or myelography from above and below the clinically affected level.

Operative Technique

Each patient was positioned prone on a Hall frame, and the operation was carried out by a neurosurgical/orthopedic team. The technique used for decompression was that described in detail in 1977 by Erickson, et al. (Fig. 1). The posterior elements were exposed as far as the tips of the transverse processes through a midline incision long enough to expose at least two levels above and below the lesion. Next, the lamina, facet, and pedicle on the involved side of the vertebra were removed using a combination of rongeur and high-speed drill, and the nerve root, thecal sac, and vertebral body were identified. Depending upon the findings at this point, either the posterior vertebral cortex of the body was undercut and impacted anteriorly or, if the cortex had been replaced by tumor, a direct curettage of tumor and bone was performed. Curettage was facilitated by the use of specially designed reverse-angle curettes with a foot 12 mm long. Resection of the pedicle allowed removal of the body and anterior tumor mass without retraction of the thecal sac. In one patient the pedicles were removed bilaterally, and in two other patients a unilateral pedicle resection was performed at several levels.

Following decompression, stabilization was achieved in most cases by Harrington distraction instrumentation and sublaminar wiring. However, individual fixation methods varied according to the region of the spine involved and the condition of the adjacent posterior elements. Bone grafting was not performed in patients with a life expectancy of less than 12 to 18 months. Postoperatively, all patients underwent aggressive physical therapy starting with sitting up on postoperative Day 1 or 2. Patients with fractures below T-8 were stabilized in a brace. Follow-up information was obtained at office visits and supplemented by telephone interviews.

Operative Results

The patient data from this series are summarized in Table 1. All six patients with preoperative neurological deficits improved. Each of the three nonambulators became ambulatory. Two patients who could walk only with assistance were able to walk postoperatively without assistance. No patient deteriorated neurologically. All four patients with back pain and/or radicular symptoms unequivocally improved with surgery. Only one patient (Case 1) still took narcotics 6 weeks postsurgery, and she took them for relief of pain from other skeletal metastases.

The average estimated surgical blood loss was 1166 ml. The average transfusion requirement was 640 cc packed red blood cells.

Three patients experienced postoperative complications. One patient (Case 1) developed pneumonia and iliofemoral deep venous thrombosis, both partially due to severe preoperative debilitation. Another patient (Case 3) underwent sigmoid colostomy on postoperative Day 23 for diverticulitis; he also developed an iliofemoral deep venous thrombosis. The third patient (Case 6) suffered a cardiac arrest and died suddenly on postoperative Day 18. Her family refused permission for an autopsy, but the cause of death was thought to be massive myocardial infarction or pulmonary embolism.

Of the five patients who were working preoperatively, four returned full-time to their prior occupations. Four patients were temporarily stabilized in a brace for pe-
One-stage posterolateral spinal decompression and stabilization

periods ranging from 5 weeks to 3 months. They wore their braces only while out of bed.

Postoperative hospitalization for patients without complications averaged 12 days, but the range for all patients was wide: from 5 to 48 days. Two patients required extensive stays in rehabilitation centers. The first of these (Case 1) spent 54 days in a rehabilitation center after 18 days in the hospital. Preoperatively, she had widespread myeloma, including brain-stem lesions, and postoperatively she sustained four pathological fractures of the extremities. The second patient (Case 3) was severely paraparetic preoperatively following prior laminectomy for a T-8 giant-cell tumor. He developed a deep venous thrombosis and diverticulitis requiring sigmoid colostomy, and spent 48 days in the hospital and 55 days at a rehabilitation center.

Illustrative Cases

Case 2

This 54-year-old man underwent a radical nephrectomy in August, 1986, for renal cell carcinoma. He did well until October, 1986, when he developed mild myelopathy from a T-4 metastatic lesion. He improved somewhat with radiation therapy and steroids, but in December, 1986, his condition worsened rapidly over i week to the point that he could take only a few steps with assistance. Magnetic resonance imaging showed cord compression at T-4. Bilateral posterolateral decompression was carried out at T-4, followed by Luque-Drummond stabilization. Increased strength (grade 4/5) and sensation were noted in both lower extremities on postoperative Day 2, and the patient was discharged walking without a brace or support on postoperative Day 5. In the 3rd postoperative week he cleared his driveway with a snowblower, although neurological examination still demonstrated a mild paraparesis. He remained ambulatory until his death from systemic malignancy 4 months later.

Case 4

This 62-year-old man presented with widespread metastases from what later proved to be a prostatic ade-

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age (yrs), Sex</th>
<th>Tumor</th>
<th>Level of Tumor</th>
<th>Preoperative Status</th>
<th>Postoperative Status</th>
<th>Follow-Up Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>49, F</td>
<td>multiple myelomas, widely disseminated</td>
<td>T-6, T-8</td>
<td>brain-stem metastasis, failed XRT to thoracic &amp; lumbar spine; post chemo, steroids: rapidly progressive paraparesis, nonambulatory</td>
<td>ambulatory, contact-guarding 8 days postop, grade 4/5 motor power bilat</td>
<td>ORIF • 4 for extremity fractures; died of systemic disease 7 mos postop</td>
</tr>
<tr>
<td>2</td>
<td>54, M</td>
<td>renal cell, with multiple bone &amp; lung metastases</td>
<td>T-4</td>
<td>moderate paraparesis after steroids &amp; XRT; walked only with assistance</td>
<td>mild paraparesis; walking without assistance 3 days postop</td>
<td>6 wks postop used snowblower to clear driveway; died of systemic disease 4 mos postop</td>
</tr>
<tr>
<td>3</td>
<td>55, M</td>
<td>giant-cell tumor</td>
<td>T-8</td>
<td>severe paraparesis, nonambulatory after acute paraplegia due to pathological fractures; treated elsewhere by T7-9 laminectomy &amp; XRT</td>
<td>mild paraparesis; regained urinary continence; persistent sensory level T-6; independent with crutches</td>
<td>uses cane 1 yr postop</td>
</tr>
<tr>
<td>4</td>
<td>62, M</td>
<td>prostate carcinoma, widely disseminated</td>
<td>T-6</td>
<td>mild paraparesis, urinary incontinence, severe back pain</td>
<td>no neurological deficit, no pain</td>
<td>3000 cGy XRT postop; returned to work; pain-free 39 mos postop</td>
</tr>
<tr>
<td>5</td>
<td>44, F</td>
<td>breast carcinoma</td>
<td>T5-7</td>
<td>severe paraparesis: only moved it great toe</td>
<td>no motor deficit, patchy hypesthesia</td>
<td>4000 cGy XRT postop; returned to full-time office work 5 wks postop; hospitalized 4 mos postop for pathological fractures it acetabulum, T-12 died suddenly 18 days postop, (7) pulmonary embolism</td>
</tr>
<tr>
<td>6</td>
<td>72, F</td>
<td>breast carcinoma</td>
<td>T-2</td>
<td>moderate paraparesis, walked only with assistance after tamoxifen &amp; XRT</td>
<td>walked independently, no motor/sensory deficit</td>
<td>no pain 9 mos postop</td>
</tr>
<tr>
<td>7</td>
<td>65, F</td>
<td>breast carcinoma</td>
<td>L-2</td>
<td>severe back &amp; radicular pain after tamoxifen &amp; XRT</td>
<td>complete pain relief</td>
<td>waterskiing, biking 17 mos postop</td>
</tr>
<tr>
<td>8</td>
<td>44, F</td>
<td>fibrous dysplasia</td>
<td>T-12</td>
<td>moderate back pain</td>
<td>no pain</td>
<td>returned to office work until MI 5 mos postop, progressive disease but still ambulatory 8 mos postop</td>
</tr>
<tr>
<td>9</td>
<td>49, M</td>
<td>renal carcinoma</td>
<td>L-2</td>
<td>severe back pain &amp; L-2 radiculopathy after XRT &amp; emboliztion × 2</td>
<td>back &amp; radicular pain resolved</td>
<td>no pain</td>
</tr>
</tbody>
</table>

* XRT = x-ray therapy; chemo = chemotherapy; ORIF = open reduction with internal fixation; MI = myocardial infarction.

J. Neurosurg. / Volume 70 / March, 1989
nocarcinoma. At presentation he complained of severe thoracic back pain, 2 weeks of progressively unsteady gait, and 1 week of urinary incontinence. Physical examination showed midthoracic tenderness, a broad-based unsteady gait, bilateral knee hyperreflexia, a left Babinski reflex, and no definite motor or sensory deficits. Myelography followed by CT showed partial obstruction of the spinal canal by an epidural mass at T-6. The patient underwent posterolateral decompression followed by Harrington/Luque stabilization from T-3 to T-9. Postoperatively, his pain and urinary incontinence resolved completely, and his gait rapidly improved. Afterward, he received irradiation, 3000 cGy to the thoracic spine. He returned full time to his job as a custodian, and worked for 2½ years until his retirement at the age of 65 years. At his latest examination, 3 years postoperatively, he remains pain-free and ambulatory.

Case 5

This 44-year-old woman underwent modified radical mastectomy in March, 1985, followed by chemotherapy for positive axillary nodes. In May, 1986, a recurrence in the chest wall was treated with radiation therapy, and in February, 1987, she underwent oophorectomy for multiple skeletal metastases. In March, 1987, after 1 month of progressive pain and left leg weakness, she suddenly developed a severe paraparesis. Only the right extensor hallucis longus was partially spared. Myelography followed by CT demonstrated an epidural mass at T-6. Steroids were given, and she underwent emergency left-sided posterolateral decompression of T-6 with Luque-Drummond fixation of T3-10. Several hours postoperatively, she was able to perform straight-leg raising on the right. She climbed stairs on postoperative Day 15, was discharged home on postoperative Day 19 without a brace, and subsequently received 4000 cGy irradiation to her spine. In the 5th postoperative week, she returned to her office job full time, using a cane for balance while walking. Four months later she required hospitalization for massive new lumbar, sacral, and bilateral acetabular metastases. At this time her neurological examination was normal except for bilateral mild unsustained clonus. Spine films (Fig. 2) showed that further collapse of T-6 had occurred, but alignment and neurological integrity had been preserved.

Discussion

Historically, the rapidly expanding literature on treatment of spinal epidural neoplasia arises from the initial descriptions of procedures for decompression of spinal tuberculous abscesses. Since the original 1779 notes by Pott on established free drainage to treat the paraplegia caused by a tuberculous abscess, many techniques for decompressing spinal lesions have been described. One of the earliest methods was costotransversectomy, first described by Menard in 1894. This technique succeeded in draining paravertebral abscesses, but failed to relieve anterior thoracic cord compression due to fixed bone deformity. In 1954, Capener addressed this problem with his technique of lateral rhachotomy. In this modification of the costotransversectomy, Capener suggested dividing the intercostal nerve at the involved level and resecting the proximal rib, transverse process, and pedicle. "At this stage, by forward depression of the pleura and intercostal vessels and backward retraction upon the intercostal nerve, a good view could be gained of the lateral aspect of the meninges as well as of the posterolateral edge of the vertebral bodies." Several years later, Hodgson and coworkers published their original work on anterior approaches to tuberculous lesions of the spine.

Subsequently, as the incidence of spinal tuberculosis decreased and that of spinal tumors increased, Western literature focused upon decompression of these lesions, which involve the bone as well as the epidural space.
One-stage posterolateral spinal decompression and stabilization

As with Pott's disease, the initial approach to decompression was posterior, by laminectomy. However, laminectomy was effective in reversing the neurological deficit in only 20% to 40% of cases,²⁻⁶,¹⁶,¹⁹,₂¹⁻²³,₂⁵,₂⁶ it was no more effective in relieving pain or neurological deficits than was radiation alone,²,₂⁹ and could indeed worsen spinal instability.²

The main problem with posterior approaches has been the inability to directly attack the compressing lesion (that is, the tumor or fragments of disc and bone which are located anterior to the cord). Therefore, recent efforts have been aimed at direct anterior approaches, with reports of unquestionably greater success. In 1984, Harrington¹⁰ reported on 52 patients who underwent anterior decompression and stabilization with Knodt rods and replacement of the vertebral bodies with methyl methacrylate. Of 40 patients with preoperative neurological deficits, 21 completely recovered, 13 improved, five remained unchanged, and one deteriorated neurologically. Sundaresan, et al.,³,⁷ in 1985, reported on 101 patients with neoplastic cord compression who underwent anterior vertebral body resection and Steinman pin/methyl methacrylate stabilization. Most of their patients experienced pain relief (85%) and marked neurological improvement (70%); 32 nonambulatory patients became walkers, and there were no inadvertent neurological deteriorations. In a series treated by similar anterior approaches, Kostuk, et al.,¹³ reported a 72% improvement rate in neurological condition, and Siegal and Siegal²⁵ reported similar excellent results.

The anterior approaches indeed constitute a quantum leap in the treatment of spinal epidural neoplasia. However, they are not without problems. In Harrington's extremely detailed report,¹⁰ there were six significant fixation problems, one cerebrospinal fluid hydropsphysis and one postoperative death due to pulmonary embolism and myocardial infarction. In Sundaresan's series,²⁷ there were five failures of fixation, four wound dehiscences, two cases of pneumonia, two myocardial infarctions, one instance of iliopelvic thrombosis with retroperitoneal hemorrhage in a patient receiving heparin, and eight additional postoperative deaths (that is, death within 30 days of surgery). Additionally, 10% of their patients required secondary posterior stabilization.

In this small series, the negative physiological impact of surgery has been minimized by avoiding transgression of the thoracic and abdominal cavities. The posterolateral one-stage decompression-stabilization procedure described by Erickson, et al.,³ in 1977 for treatment of thoracolumbar fractures can be used successfully for the treatment of anterior spinal epidural neoplasia. This technique offered adequate decompression, as judged by neurological improvement, in all six patients and relief of pain in all of four patients. No clinically significant problems occurred with fixation, although in one patient (Case 5) the Luque-Drummond fixation allowed the spine to telescope as the T-6 vertebral body collapsed (Fig. 2). Spinal alignment was maintained, and there were no adverse mechanical or neurological consequences.

A major goal of operating on patients with metastatic disease is to return them home with functional independence as soon as possible. An average hospital stay of 12 days for patients without complications compares favorably with the period required for anterior approaches. It is also gratifying that four patients returned to full-time work.

Today, few would dispute the appropriateness of aggressive treatment for patients with spinal neoplasia. Rather, the debate is over the efficacy of particular techniques, both surgical and nonsurgical. Laminectomy has been proved ineffective. Radiotherapy is effective in relieving pain and as an adjunct to surgery, but does not relieve instability or compression caused by fixed bone elements. Chemotherapy and endocrine therapy may shrink tumors, but do not affect spinal stability or compression caused by bone elements. Anterior approaches have been shown to be effective in improving neurological deficits as well as relieving mechanical pain and instability; however, they can be associated with significant morbidity, and may require special surgical techniques, and further posterior stabilization. The one-stage posterolateral approach is less invasive, requires no special surgical techniques, and may be associated with less morbidity and shorter hospitalization. Blood loss seems to be less for the posterolateral approach: blood replacement in Harrington's series,¹² averaged 1200 cc versus 640 cc in our series.

Although our study is small, it supports the concept that significant anterior decompression can be achieved via a posterolateral approach. The only other similar studies published thus far are those of Lesoin, et al.,¹⁸ and Faccioli, et al.,³⁰ who achieved neurological recovery in 18 of 20 patients and eight of nine patients, respectively, using the same approach. This series presents the posterolateral approach not as a substitute for the anterior approach, but simply as another alternative in the surgical armamentarium against spinal epidural neoplasia.

Acknowledgment

The authors thank Lisa S. Flaherty for preparation of the manuscript.

References

5. Erickson DL, Leider LL Jr, Brown WB: One-stage decomp-

Manuscript received November 16, 1987.
Accepted in final form August 29, 1988.
Dr. Borges is supported by Clinical Investigator Development Award KO8N00990 from the National Institutes of Health.
Address reprint requests to: Lawrence F. Borges, M.D., Neurosurgical Service, Massachusetts General Hospital, Fruit Street, Boston, Massachusetts 02114.