Harrington rod stabilization for pathological fractures of the spine

NARAYAN SUNDARESAN, M.D., JOSEPH H. GALICICH, M.D., AND JOSEPH M. LANE, M.D.
Neurosurgery and Orthopedic Services, Memorial Sloan-Kettering Cancer Center, New York, New York

Nineteen patients with tumors involving the thoracolumbar spine were treated by Harrington rod stabilization following laminectomy. Sixteen patients had metastatic neoplasms, and three had primary tumors of the vertebral column. In five patients, extensive decompressive laminectomy and Harrington distraction rods to provide immediate stability were used as initial treatment; postoperative irradiation was then given. All five patients were ambulatory, and the four patients with preoperative pain all noted relief of pain following treatment. The remaining 14 patients had received radiation therapy to the spine prior to surgery; in these 14, indications for surgery included a combination of pain and weakness (10 patients), pain alone (two patients), or weakness alone (two patients). Of 12 patients with preoperative pain, after surgery pain relief was noted in nine patients, and eight were ambulatory. Major wound breakdowns occurred in two of the 14 patients who had received radiation prior to surgery. These results suggest that Harrington rod instrumentation is useful in providing postoperative stability and restoring alignment following laminectomy for tumors involving the spine, but carries an increased risk of wound-related complications if used in a previously irradiated region.

KEY WORDS • Harrington rod fusion • decompressive laminectomy • fracture-dislocation • cord compression • spinal cord • spine tumors

Most fracture-dislocations in the lower thoracic and the lumbar region result from trauma; currently, stabilization with Harrington rod instrumentation is recommended in those patients with unstable fractures.3,5,13 Advantages cited for operative treatment include relief of pain, reversal of neurological deficits by realignment of the spine or by removal of bone fragments compressing the cord, and an overall shortened period of hospitalization. The need for stabilization may occasionally arise in patients with neoplasms involving the spine. Both acrylic (methyl methacrylate) and Harrington rod instrumentation have been advocated for posterior stabilizations in patients with cancer, in view of their limited life expectancy.4,8,14,18 Despite an extensive literature on the use of Harrington rods in trauma, its utility in pathological fracture-dislocations has only rarely been reported.18 We have, therefore, reviewed our experience with Harrington rod stabilization in this group of patients.

Summary of Cases

Clinical Data

From July, 1977, through December, 1982, 19 patients with tumors of the spine had insertion of Harrington rods at this institution. Sixteen patients had metastatic cancer, and three had primary tumors (osteogenic sarcoma in two, and myeloma in one). The sites of primary cancer in the former group were diverse: breast (three), prostate (two), thyroid (two), soft-tissue sarcoma (two), lung (one), colon (one), cervix (one), kidney (one), bladder (one), testis (one), and unknown (one). Nine patients were male, and 10 were female. Their ages ranged from 18 to 72 years, with a median of 50 years. In five patients, initial treatment consisted of resection of involved bone and extradural tumor by a posterior approach with insertion of Harrington distraction rods. These patients then received radiation therapy to the involved spine. The remaining 14 patients had received radiation therapy for epidural cord compression at varying intervals prior to surgery. Ten of these patients presented with both intractable pain and progressive weakness. Two patients were operated on for severe back pain alone; two others underwent surgery because of progressive weakness of the lower extremities during the course of radiation therapy.

Radiological Evaluation

All patients had plain x-ray films and myelography to determine the extent of the tumor. Computed tomography (CT) of the spine was used in the last 10
Stabilization of pathological spine fractures

![Image](https://example.com/fig1.jpg)

**Fig. 1.** *Left:* Anteroposterior x-ray film of the lumbar spine showing collapse of the L-4 vertebra due to multiple myeloma. *Right:* Computerized tomography scan showing destruction of the entire body with involvement of the pedicle on the right side.

...patients to delineate the involvement of bone and soft tissue by tumor. Tomography was used to distinguish between bone compression and soft tumor in the presence of anterior epidural defects in four patients.

The level of spine involvement included the lower thoracic segments in nine patients and the lumbar region in 10 patients. Compression fractures involving a single vertebral body were noted in 18 patients; significant collapse (loss of vertebral height greater than 25%) was seen in 11 patients, wedge fractures in seven patients, and involvement of the transverse process and pedicle alone in the remaining patient.

Myelography revealed a complete block in 14 patients, partial block in three patients, and no epidural defect in the remaining two patients. In eight patients, the block was attributed to protrusion of a collapsed vertebral body into the spinal canal without significant compression by epidural tumor. Following surgery, repeat myelography was carried out in 12 patients to determine whether the block had been relieved, and plain radiography was used to check alignment of the spine (Figs. 1–4).

**Surgical Technique**

The technique used for the distraction rod instrumentation was that described in previous reports by Harrington, with some modifications. Seventeen patients (excluding the two patients with normal myelogram) initially underwent wide laminectomy for tumor resection. Removal of facets not only allowed decompression of the involved nerve roots, but also provided access to the anterior aspect of the spinal canal. Following removal of all identifiable tumor, the hooks were seated into facet joints two levels above the laminectomy, and the lower hooks under the lamina two levels below. In the lumbar region, we avoided placing the lower hook on the L-5 vertebra as recommended by Harrington; sacral alar hooks were used in two patients, and a sacral bar was inserted in one. The distracting rods were then inserted, and minimal to moderate distraction was applied in a staggered fashion. Intraoperative x-ray films were taken in the presence of subluxation to determine proper alignment. The two rods were then wired together at both ends with No. 18 wire, and the ends embedded in methyl methacrylate. Postoperatively, the patients were allowed to walk in a molded plastic (Prenyl) jacket.

**Results of Treatment**

The results of treatment are shown in Tables 1 and 2. The patients are analyzed separately according to whether surgery was performed as initial treatment (five
FIG. 3. Left: Myelogram showing partial collapse of a lumbar vertebra due to metastasis from bladder cancer. Right: Repeat myelogram 3 months following irradiation showing progressive collapse of the vertebral body. At that time there was a recurrence of symptoms. Dotted lines outline retropulsion of bone posteriorly.

FIG. 4. Myelograms in a patient with breast cancer. Left: Fracture-dislocation secondary to laminectomy which was performed for relief of pain due to collapse of L-2. Right: Both Harrington instrumentation posteriorly, and anterior decompression and stabilization with methyl methacrylate were necessary to relieve neurological deficit and pain.

patients), or whether it was performed in patients in whom maximal previous irradiation to the spine had failed to give relief (14 patients). Pain was considered to be “significant” if it could not be controlled by narcotic and steroid therapy. “Improvement” of pain was defined by reduction in narcotic therapy postoperatively, and by the patients’ subjective evaluation of pain relief. Although the majority of patients reported pain relief, only three patients were weaned completely off narcotics; all three patients with primary bone tumors are long-term survivors, and are currently free of disease.

Preoperative motor deficits were classified into four major categories (Table 2). Although some improvement in motor function was noted in all patients following surgery, we considered patients to be “improved” only if they were ambulatory. Two patients who had deteriorated acutely while undergoing radiation therapy did not receive substantial benefit from surgery. Associated sphincter involvement was noted in four paraparetic patients, only one of whom improved postoperatively. Repeat myelography showed clearing of the block in 10 of 12 patients so evaluated, and normal alignment of the spine was achieved in all 12 patients.

Wound-related complications were noted in four previously irradiated patients; two developed major dehisences of the laminectomy wound, and two others had minor breakdowns requiring nursing care alone. Dislocation of the lower hook, with operative repositioning was required in one patient. Late complications included recompression at the operative site 2 months after surgery in one patient, and subluxation of the

TABLE 1
Results of treatment for relief of pain

<table>
<thead>
<tr>
<th>Group*</th>
<th>No. of Cases</th>
<th>Preop Pain</th>
<th>Postop Pain Relief</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>B</td>
<td>14</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>total cases</td>
<td>19</td>
<td>16</td>
<td>13</td>
</tr>
</tbody>
</table>

*Group A: initial surgery followed by irradiation; Group B: previous irradiation to involved spine failed to give relief.

TABLE 2
Results of treatment according to motor deficit

<table>
<thead>
<tr>
<th>Group &amp; No. of Cases</th>
<th>Preop Status</th>
<th>Motor Deficit</th>
<th>No.</th>
<th>Postop Status*</th>
</tr>
</thead>
<tbody>
<tr>
<td>A: 5</td>
<td>normal strength</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>radicular deficit</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>moderate paraparesis</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>severe paraparesis</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>B: 14</td>
<td>normal strength</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>radicular deficit</td>
<td>5</td>
<td>5†</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>moderate paraparesis</td>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>severe paraparesis</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

*All five Group A patients and eight of the 14 Group B patients were ambulatory after treatment.
†One patient subsequently died due to postoperative complications.
Stabilization of pathological spine fractures

vertebral body 6 months later due to tumor regrowth in another. This complication was successfully treated by transthoracic decompression and fusion. Two others developed a second site of spinal cord compression several segments above the original level of the block. The overall median survival for the entire group was 5 months. Six patients (30%) lived 1 year or more, and continued ambulatory until death. Four patients (two with osteogenic sarcoma, one with myeloma, and one with thyroid carcinoma) have lived 2 years, and continue to be ambulatory.

Discussion

The role of surgery in the management of patients with spinal metastases continues to be debated, since current results of treatment are unsatisfactory. Although decompressive laminectomy used to be advocated as initial treatment of cancer patients who presented with clinical signs of cord compression, the demonstration that the results of such a strategy were no better than that achieved by external radiation and steroid therapy alone have led many to advocate that radiation therapy should be used in the primary treatment of all patients with spinal metastases. However, compression of the spinal cord results from several different mechanisms. Although direct extension of the tumor from within the vertebral body to the epidural space accounts for the clinical syndrome in the majority of cases, structural abnormalities such as collapsed vertebrae or subluxations may be responsible in 10% to 25% of patients. Our data suggest that radiation therapy alone is less likely to be effective in such situations, and surgical treatment including stabilization procedures should be considered.

Although the concept of providing surgical fixation of an obviously unstable spine appears logical, the diagnosis of "clinical instability" may be difficult to make when evaluating compression fractures. Holdsworth considered the majority of such fractures to be stable injuries except when displacement was present. These concepts may require modification, especially as CT often reveals osseous destruction that is more extensive than that apparent on plain radiography. Unfortunately, criteria that have been developed for the diagnosis of instability apply only to traumatic fractures, and similar criteria for pathological compression fractures are not available. Loss of stability following decompressive laminectomy is also thought to be a possible factor that accounts for the occasional neurological deterioration following decompressive laminectomy, especially when the vertebral body is collapsed. We therefore suggest that posterior fusion be considered in the following situations: 1) whenever progressive collapse of the vertebral body is noted on serial plain radiography (Fig. 3); 2) following extensive resection of facets bilaterally, which may be required to provide nerve root decompression, or to allow access to the anterior aspect of the cord; and 3) for pathological fracture-dislocations with marked displacement, to reinforce anterior decompression and fusion (Fig. 4).

Of the two surgical techniques currently available for immediate posterior stabilization, Harrington instrumentation offers an important advantage over acrylic fusion. Through the use of moderate distraction, restitution of vertebral height is possible, and may result in a more normal alignment of the spine. Further, the rods themselves exert an anteriorly directed force vector that is effective in reducing a localized kyphosis. This vector may be lost if facets are resected; progressive tumor growth may then result in late secondary displacement, as was seen in one of our patients.

Although posterior fixation was useful in alleviating pain in the majority of patients in our series, substantial morbidity from poor wound healing was encountered in those who had received radiation therapy prior to surgery. With the current emphasis on radiation therapy as initial treatment, these patients unfortunately are more representative of those likely to be referred for surgical treatment. In patients in whom disease is localized to a single spinal segment, an effective alternate surgical approach which holds considerable promise is anterolateral decompression and fusion. Since the operative incision lies outside the previously irradiated field, problems related to poor wound healing are avoided. Although these operative procedures are considerably more extensive than simple decompressive laminectomy, careful selection of the proper surgical approach may improve upon results currently reported in the literature. We believe that aggressive treatment of spinal metastases is important, not only for palliation, but because more recent data indicate that effective treatment of this complication has a direct bearing on survival.

Addendum

Since this manuscript was accepted, Cusick, et al. (Cusick JF, Larson SJ, Walsh PR, et al: Distraction rod stabilization in the treatment of metastatic carcinoma. J Neurosurg 59:861-866, 1983), have reported a smaller series of patients, stressing the value of Harrington rod stabilization in the treatment of metastatic carcinoma involving the spine.

References

4. Dunn EJ: The role of methyl methacrylate in stabilization

J. Neurosurg / Volume 60 / February, 1984


---

Manuscript received March 31, 1983.

Accepted in final form August 30, 1983.

Address reprint requests to: Narayan Sundaresan, M.D., Neurosurgery Service, Memorial Sloan-Kettering Cancer Center, 1275 York Avenue, New York, New York 10021.

N. Sundaresan, J. H. Galicich and J. M. Lane