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Abstract

We report herein the results of anterior or posterior neural decompression with spinal stabilization in 16 patients with spinal metastases. Intractable back pain was relieved in 14 patients (87.5%) and 4 had complete pain relief. Neurologic recovery was observed in 8 out of 13 patients (61.5%) who had some neurologic deficits before surgery. The activities of daily living improved in 7 of 9 (77.7%), and 5 out of 8 patients (62.5%) who had been unable to walk before surgery became ambulatory after surgery. The average operation time was 3h 15 min with an average blood loss of 2150 ml. No patient died within 1 month after surgery and the median survival was 19.1 months. The results indicated that, if properly indicated, anterior or posterior neural decompression and spinal stabilization is a safe and effective treatment for patients with spinal metastases to improve the quality of life for the patients' remaining years.

KEYWORDS: spine, neoplasm, metastasis, operation, stabilization

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Surgical Treatment for Metastatic Tumors of the Spine

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We report herein the results of anterior or posterior neural decompression with spinal stabilization in 16 patients with spinal metastases. Intractable back pain was relieved in 14 patients (87.5%) and 4 had complete pain relief. Neurologic recovery was observed in 8 out of 13 patients (61.5%) who had some neurologic deficits before surgery. The activities of daily living improved in 7 of 9 (77.7%), and 5 out of 8 patients (62.5%) who had been unable to walk before surgery became ambulatory after surgery. The average operation time was 3h 15min with an average blood loss of 2150ml. No patient died within 1 month after surgery and the median survival was 19.1 months. The results indicated that, if properly indicated, anterior or posterior neural decompression and spinal stabilization is a safe and effective treatment for patients with spinal metastases to improve the quality of life for the patients' remaining years.

Key words: spine, neoplasm, metastasis, operation, stabilization

Metastatic spinal tumors are not uncommon for patients with malignant neoplasms (1). Their occurrence is increasing paradoxically in parallel with improved oncological care and prolonged survival for patients with advanced diseases. Metastatic lesions involving the spine bring about pain and paralysis caused by destruction of the spinal column and compression of the nervous system. The pain may be severe enough to make a patient lie absolutely still. The patient may not be able to sit, stand or walk, even with the use of a spinal orthosis. Radiotherapy can relieve these symptoms to some extent, however, there are patients who experience neural deterioration during radiotherapy and those with vertebral body collapse resulting in spinal instability. These patients cannot be managed successfully by irradiation alone. Like pathological fractures in other regions, immobilization of the affected bone is required for pain relief. Conventional decompressive laminectomy in such patients rarely relieves pain or improves neural function (2, 3). In addition, it may render the spine more unstable by destroying the posterior spinal column. Since 1985, we have performed anterior or posterior neural decompression with spinal stabilization for these patients. This study presents the results of these 16 consecutive patients.

Patients and Methods

Between January 1985 and August 1993, 16 patients with spinal metastases were treated by cord decompression and spinal stabilization. All patients complained of moderate to severe back pain and 13 had clinical evidence of neurologic deficits secondary to the spinal tumors. Eleven patients were men and 5 were women. The ages of the patients ranged from 16 to 74 years with an average of 56.5 years. The primary tumors were lung in 6, prostate and thyroid in 2 each, and kidney, orbit, colon, breast, ovary, and of unknown origin in 1 each.

Five patients (31.3%) had a spinal symptom as the first sign of malignant disease, the primary tumor having been unrecognized. The other 11 patients were known to have a malignant disease before development of the spinal lesions. The duration between the diagnosis of the primary tumor and development of the spinal symptoms was from 1 week to 26 years with an average of 45 months. The vertebra operated on was the cervical spine in 4, the thoracic spine in 4, and the lumbar spine in 7. There was 1 patient in whom both the 12th thoracic and the 1st

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Table I Operative procedures and instruments

	Number of cases
Harrington rod + laminectomy	4
Cotrel Dubousset instrumentation + laminectomy	4
Luque SSI + laminectomy	2
Cotrel Dubousset instrumentation	1
Vertebral body replacement	5
Total	16

lumbar vertebrae were treated.

Radiological investigations included plain radiography and myelography. Computed tomography (CT) and magnetic resonance imaging (MRI) of the spine and bone scintigraphy using 99mTc-HMDP were performed to determine the extent of the disease more precisely.

Posterior spinal stabilization (Harrington rod, Cotrel Dubousset, Luque SSI) along with posterior decompressive laminectomy was performed in 10 patients and posterior stabilization (Cotrel Dubousset) without laminectomy in 1. Anterior decompression and vertebral body replacement was performed in the other 5 patients. Several instruments were used for spinal stabilization after decompression of the spinal column (Table 1). Recently, segmental spinal stabilization using Cotrel Dubousset instrumentation has become widespread. Nine patients received radiotherapy (40–50 Gy) to the involved vertebra either preoperatively (3 patients) or postoperatively (6 patients).

The treatment results were assessed in relation to the improvement of pain, neurologic deficit, and activities of daily living (ADL). The pain was evaluated on a scale of 1 to 5 according to Denis's criteria (4). Neurologic symptoms were divided into 5 groups according to the grades of Frankel (5). ADL was divided into 4 classes mainly by the ability to walk (6). The assessments were performed usually 1 month after the operation. Cumulative survival was calculated by the Kaplan-Meier method.

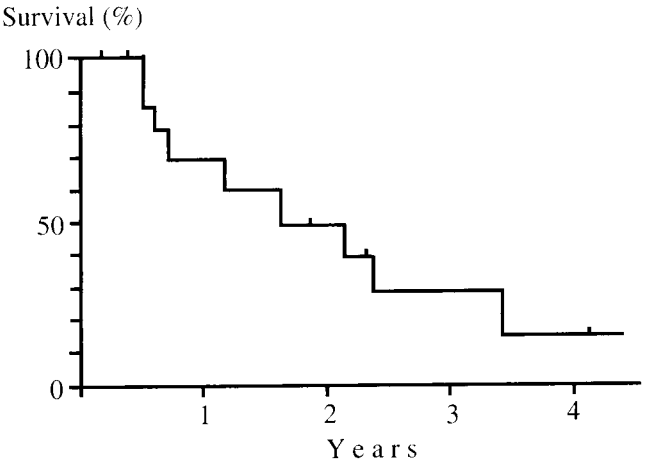

Fig. 1 Cumulative survival of the patients after surgery.

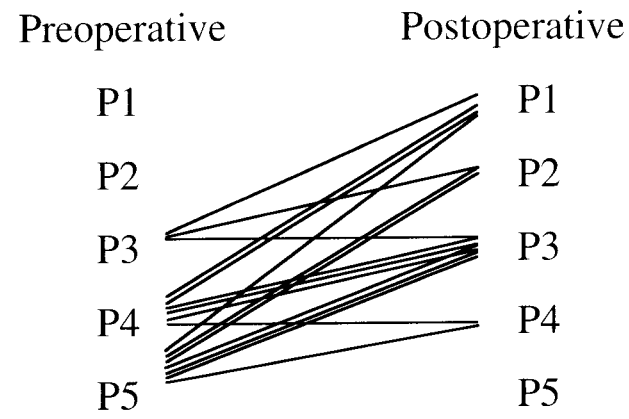

Fig. 2 Results of surgery with regard to pain relief.
P1: No pain. **P2**: Occasional minimal pain with no need for medication. **P3**: Moderate pain with occasional medication but no interruption of work or significant change in activities of daily living (ADL). **P4**: Moderate to severe pain with frequent medication and occasional absence from work or significant change in ADL. **P5**: Constant or severe incapacitating pain, chronic medication.
P1~P5: according to the criteria of Denis *et al.* (1984) (4).

Results

The average operation time was 3 h and 15 min: 3 h and 10 min for posterior surgery, and 3 h and 30 min for anterior surgery. The average blood loss during the operation was 2150 ml: 2586 ml for posterior surgery, and 1190 ml for anterior surgery. No specific complications, such as wound infection, cerebrospinal fluid leakage, or meningitis, occurred following surgery.

No patient died within 1 month after the operation. Four patients died within 6 months: two of lung cancer,

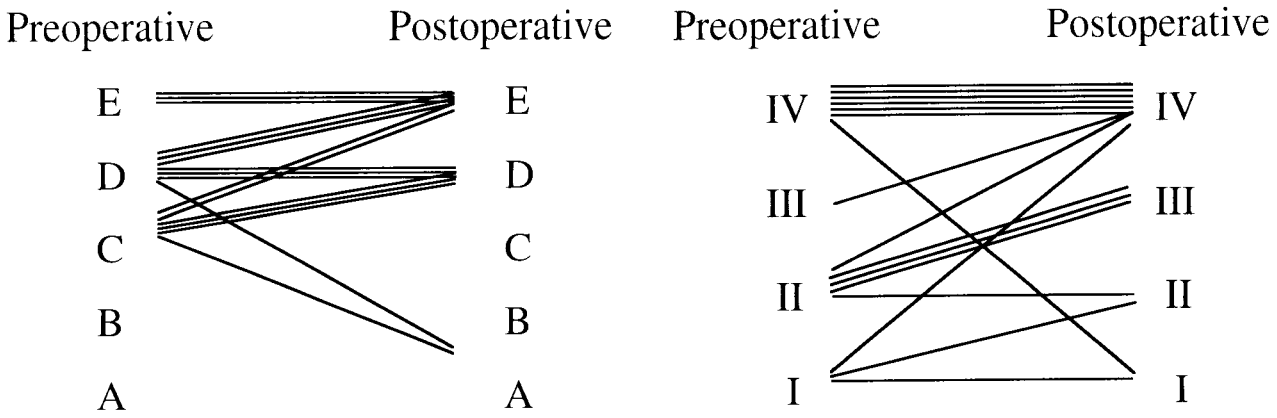

Fig. 3 (Left) Results of surgery with regard to neurologic recovery.
A: Complete lesion. **B**: Some sensation present. **C**: Some motor power present, but of no practical use. **D**: Motor useful, sufficient for walking with or without aids. **E**: No neurologic symptoms, but abnormal reflexes present.
A~**E**: according to the criteria of Frankel *et al.* (1969) (5).

Fig. 4 (Right) Results of surgery with regard to ADL.
I: Lying still on the bed. **II**: Able to go to toilet using a wheel chair. **III**: Able to walk in the hospital. **IV**: Able to walk outdoors.
I~**IV**: according to the criteria of Mikami *et al.* (1985) (6). ADL: See Fig. 2.

one of colon, and one of cancer of unknown origin. At the time of the last follow-up, 11 patients had died and 5 were alive with a median survival of 19.1 months (Fig. 1). The causes of death were all either primary or metastatic visceral tumors. There were 4 patients (one each with lung, kidney, prostate, and orbit cancer) who had survived for more than 24 months.

Back pain was improved in 14 patients (87.5 %), but 2 patients continued to suffer the same intensity of pain postoperatively (Fig. 2). Complete pain relief was achieved in 4 patients (25.0 %). No patient complained of increased pain after the operation.

Before the operation, all but 3 patients had some neurologic deficits; however, there was no patient with complete paraplegia. The neurological recovery after the operation is shown in Fig. 3. Eight patients (61.5 %) had some neurological improvement and 3 patients showed no recovery. Worsening of the pre-existing neural deficits was noted in 2 patients: in 1 after excessive bleeding (12,000 ml) caused by laminectomy and posterior Cotrel Dubousset instrumentation for a T9 metastasis of a kidney cancer, and in the other who had a rapidly growing metastatic tumor, after vertebral body replacement for an L3 metastatic lesion of unknown origin. Postoperative compression (hemorrhage and tumor) of the spinal cord brought about catastrophic change in the neurological function.

The ADL of the patients before and after the operation is shown in Fig. 4. It was improved in 7 of 9 patients (77.7 %) who had some dysfunctions before surgery. Five out of the 8 patients (62.5 %) who had been unable to walk before surgery became ambulatory after surgery. These improvements continued to the time of last follow-up or to the patients' death.

Case Presentation

Case 1. A 16-year-old girl had acute onset of paresis 4 days after surgery for ovarian cancer. Roentgenograms revealed collapse of the L4 vertebra, and myelograms showed cord compression at the same level (Fig. 5 A, B). Even though chemotherapy was continued for 4 months, neurologic dysfunction progressed and severe back pain continued. Before surgery, she could not walk and had lost her sphincter control. At surgery, laminectomy of the L4 vertebra and segmental stabilization with a Harrington rod and sublaminar wiring from vertebrae L2 to S1 were performed (Fig. 5 C, D). Removal of the tumor was not attempted. After the

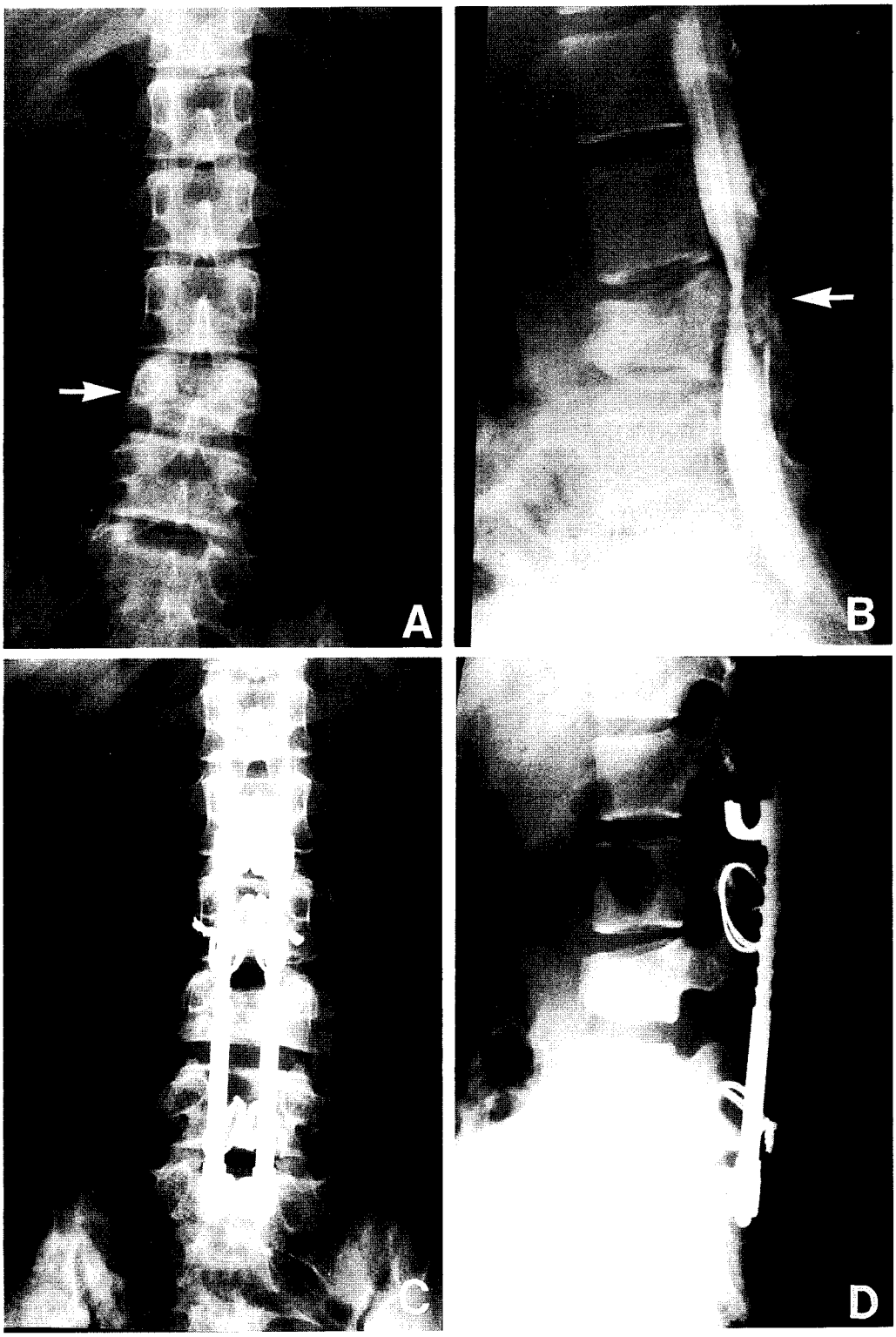

Fig. 5 Roentgenography of case 1. **A**. Preoperative roentgenogram. Partial collapse of the L4 vertebra is observed. **B**. Preoperative myelogram. Anterior and posterior cord compression is observed. **C**, **D**. Postoperative roentgenograms. Segmental spinal stabilization is shown from the L2 vertebra to the S1 vertebra. The L4 vertebra is lamminectomized.

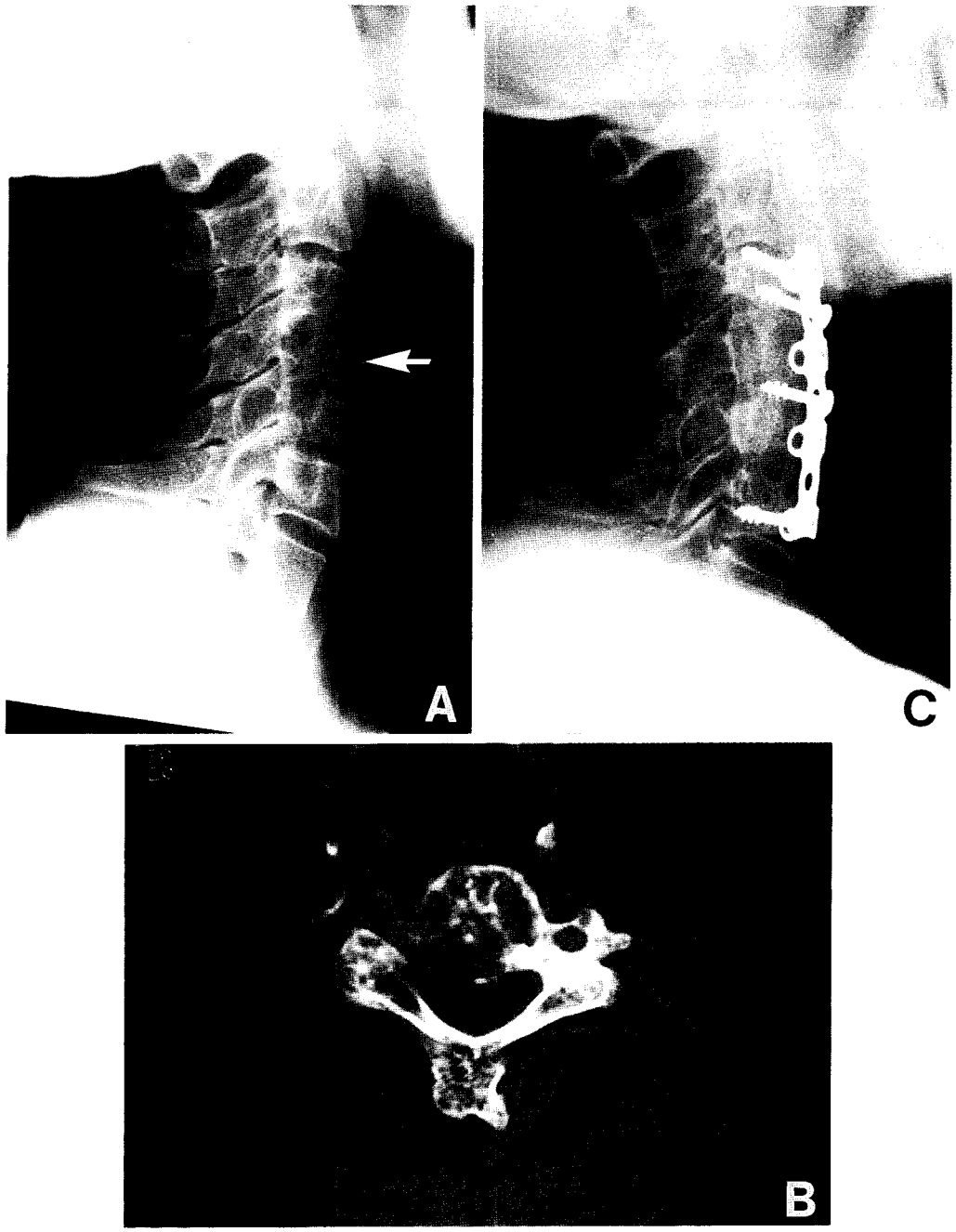

Fig. 6 Roentgenography and computed tomography (CT) of case 2. **A**. Preoperative roentgenogram. Destruction of the C4 and C5 vertebrae is observed. **B**. Preoperative CT. The body and pedicle of C4 are destroyed.
C. Postoperative roentgenogram. Anterior stabilization from the C3 to the C6 vertebrae is accomplished by using autogenous bone, a plate and screws.

operation, the pain was relieved (preoperative P3 to postoperative P1) and she became able to walk with a single cane (preoperative Frankel C, class II to postoperative Frankel D, class III). She died from the disseminated disease 21 months postoperatively; however, she remained ambulatory with pain relief until her death.

Case 2. A 41-year-old man had spinal metastasis of a mixed tumor of the lacrimal gland. He suffered severe nape pain and sensory change in the right upper extremity. Roentgenograms and CT scan revealed lytic destruction of the body and pedicle of the C4 and C5 vertebrae (Fig. 6A, B). Vertebral body resection followed by reconstruction with autogenous bone using a plate and screws was performed (Fig. 6C). Postoperatively, the pain was reduced from P5 to P2 and the neurologic grade was changed from Frankel D to E. The status of ADL (class IV) was not changed. He continued to live for 14 months after surgery without pain or neurologic symptoms.

Discussion

Within the skeletal system, which is a frequent site of distant metastases, the vertebral column is the most commonly involved with metastatic tumors. By an autopsy study, Moriwaki demonstrated that the most frequent site of involvement was the lumbar spine (69.1 %) followed by the sternum (41.7 %) and the ribs (31.7 %) (7). Pain and paralysis caused by the spinal metastatic lesions seriously affect the ADL of the patients and their quality of life. Treatment for patients with spinal metastases has been a difficult problem in medicine. During recent decades, the philosophy regarding the treatment of spinal metastases has undergone considerable change. In the past, surgeons had been reluctant to operate on a patient with metastatic spinal tumors, because the survival might be too short for the patient to benefit from the surgery. However, recently, improvement in cancer treatment has prolonged the survival of patients with spinal metastases, especially with cancers sensitive to chemotherapy and endocrine therapy.

It is widely accepted that the more severe the neurologic deficit the less likely postoperative neurologic recovery. In general, complete paraplegia is not an indication for surgical decompression except for patients with gradual onset of paraplegia which had been completed within the previous 72h. We think it is important to decompress the neural elements as soon as possible to avert catastrophic neurologic damage even for a patient whose symptoms originate from a metastatic tumor.

Our principle indications of surgery for spinal metastatic tumors are: (**a**) the patient can bear the operation and is expected to live longer than 3 months, (**b**) the patient suffers considerable pain and/or progressive neurologic symptoms from the affected lesion, (**c**) chemotherapy and/or radiotherapy was effective, (4) informed consent is given. As a rule, patients with disseminated spinal metastases are excluded. Previous treatments for the primary tumors are taken into consideration, however, the presence of residual tumors is not considered as a contraindication for resection of spinal tumors.

The results of decompressive laminectomy, which had been generally used for spinal metastases until the 1980s, were disappointing. In a prospective study, Young *et al.* demonstrated that there was no significant difference in efficacy between laminectomy followed by radiotherapy and radiotherapy alone with regard to pain relief, improved ambulation, or improved sphincter function (8). Hall and MacKay reported that 39 % of patients with posteriorly located tumors were improved by posterior decompression without stabilization; however, only 9 % of patients with anteriorly located tumors received benefit (2). The majority of spinal metastases arise in the vertebral body where they are rarely accessible from a posterior approach. Furthermore, removal of the posterior elements adds to the instability of the spine, which has already been weakened by the tumor involvement (9). Therefore, we consider that conventional posterior laminectomy should be limited to relieving the pressure on the spinal cord from the posterior enlarging tumors or to making a histological diagnosis of a tumor of unknown origin.

Several authors suggested that the anterior stabilization is most appropriate for spinal metastatic tumors (10, 11, 12). Posterior operations, nevertheless, still have an important role (13). Anterior stabilization is not indicated for patients with more than 3 vertebrae involved, a situation which is not uncommon in cancer patients. Moreover, the posterior approach is more expedient for local conditions than anterior surgery. Provided complete decompression of the neural elements and spinal stabilization are achieved, we believe that it does not matter whether the approach is anterior or posterior. In the present study, there was no significant difference in the improvement of pain, neurologic deficit and ADL between the anterior and posterior operations (data not shown).

The immediate stabilization of the spinal column is important to avoid further neurologic damage and to allow early rehabilitation of the patient. To achieve adequate spinal stability, instruments for a posterior operation should be fixed at least 2 vertebrae above and 2 or 3

vertebrae below the affected lesion (13). Anterior vertebral body replacement should be performed between 2 vertebrae which have sufficient bony stock without tumor invasion. Preoperative evaluation of the tumor using bone scintigraphy, CT and MRI helps in planning the procedure of the surgery.

The encouraging result of this study-pain relief, 87.5 %; neurologic recovery, 61.5 %; improvement of ADL, 77.7 %; and a postoperative median survival of 19.1 months- shows that, when properly indicated, surgical management of spinal metastases is safe and effective for patients with advanced cancer. There were some patients who achieved good pain control after surgery even without clear neurologic recovery. We propose that surgical treatment is also indicated for patients who suffer intractable pain which is resistant to conservative treatment. Internal stabilization of the affected spinal column may allow the patient to be managed outside the hospital with less need for supportive care. In conclusion, anterior or posterior neural decompression and spinal stabilization is an effective treatment method for patients with spinal metastases to improve the quality of life for their remaining years.

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