

Surgical palliation of symptomatic spinal metastases

How I do it

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Spinal metastases are common in malignant disease. For selected patients with severe pain or neurological dysfunction, surgical treatment offers valuable palliation. During the last few years, we have treated between 100 and 120 patients annually with spinal metastases at the Department of Orthopedics, Uppsala University Hospital, Uppsala, Sweden.

A detailed preoperative analysis is mandatory for optimal patient selection. Preoperative embolization of spinal metastases of renal cell carcinoma mini-

mizes the peroperative blood loss. Most cervical spinal metastases are best treated via an anterior approach with vertebral body resection and primary reconstruction of the anterior column. Most thoracic or lumbar spinal metastases are best treated via a posterior approach with decompression and stabilization, using a transpedicular fixation device. However, in patients with an expected survival exceeding 6–12 months, a secondary reconstruction of the anterior column should be considered.

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The skeleton is the third commonest site for malignant metastatic deposits, preceded only by the lungs and liver (Hendrickson and Sheinkop 1975). In the skeleton, the spine is the commonest location (Jaffe 1958). The clinically important symptoms of metastases in the locomotion system are pain and loss of function. The pain can be secondary to tumor growth in the bone tissue but becomes more pronounced when the bone loses its mechanical integrity and a pathological fracture develops (Fidler 1985, Denis 1983, Galasko 1991).

The loss of function caused by a pathological fracture is similar to that seen after a traumatic fracture. Dysfunction after a pathological vertebral fracture can also be secondary to mechanical forces exerted on the spinal cord and nerve roots (Denis 1983, Olerud et al. 1992, Jónsson et al. 1994a). Kyphotic deformity or translatory displacement can reduce the volume of the spinal canal, and tumor tissue or fracture fragments can directly compress the neural tissue. Loss of function can also be caused by the infiltration of tumor cells into neural tissue.

Goals in treatment of spinal metastases

A malignant tumor that has spread to the skeleton is by definition disseminated. Curative surgery is not possible and there is no indication to excise the me-

tastasis in order to free the patient from the tumor; the goal of operative treatment of a spinal metastasis is in most cases palliative (Sjöström et al. 1993). Only in rare cases can an excision of a metastasis be indicated in order to reduce the tumor burden for the patient, thus facilitating other oncological treatment.

The treatment aims at counteracting the negative effects of the metastasis: pain and dysfunction. In cases of mechanical insufficiency or pathological fracture, the deformity is reduced and the spine is stabilized. In cases of neural dysfunction due to compression of neural tissue, decompression is also performed. Prophylactic stabilization in cases of impending fracture may also be performed, just as in lytic metastases in long bones (DeWald et al. 1985).

Preoperative investigations

The preoperative investigations aim at delineating the metastasis, defining how the spine is affected in terms of neural involvement and stability, and charting of the extent to which the individual is affected by the malignant disease. Questions that need answering are: In what way is the neural tissue affected—how is decompression best achieved? What parts of the skeleton are mechanically dysfunctional and what parts are intact—what requires stabilization? In what way will stability be influenced by the planned decompres-

sion? How many motion segments will have to be stabilized? Where can secure anchorage for the fixation device be achieved?

Patients with symptomatic spinal metastases are usually severely ill and have a short life expectancy. Their tolerance for major surgery may be limited; it is, thus, important to evaluate their expected survival time and general condition (Onimus et al. 1986, Jónsson et al 1996). Factors influencing this are chiefly the following: type, aggressiveness, and degree of dissemination of the tumor (Siegal and Siegal 1989, Kostuik and Weinstein 1991, Bauer and Wedin 1995). According to Tokuhashi et al. (1990), a prognostic survival time score summarizing the dissemination of a tumor, can be based on the results of liver function tests, chest radiographs, and technetium scan of the skeleton. An oncologist may be consulted to obtain a qualified assessment of the patient's general condition, to discuss alternate treatment possibilities and to co-ordinate an operation with other treatment modalities.

In our series, 1/4 of the patients with spinal metastases presented without a known primary tumor. Some information regarding the origin of the metastasis can be provided by the spine radiographs—i.e., prostate cancer may have a characteristic appearance. In most patients with an unknown malignancy, the origin of the spinal metastasis can usually be outlined by a thorough clinical examination, routine blood investigations including serum electrophoresis, liver function tests, analyses for blood in feces and urine, and chest radiographs, ultrasound or CT of the abdomen. If the nature of the primary tumor remains obscure after this basic “work-up”, a CT-guided needle biopsy is performed to obtain a histological diagnosis. With these basic investigations, more than 3/4 of the patients will have received their diagnosis. If an operation is indicated without delay, the preoperative investigations are limited. A biopsy is taken during surgery and the investigations are completed postoperatively.

The radiographic investigation of the spine includes plain radiographs of the index vertebra, with margins wide enough to rule out metastases in adjacent vertebrae. Multiple metastases are common and the entire spine should be examined. The presence of multiple metastases is probably best evaluated with MRI, but a technetium scan may also be useful. The exact mapping of the involvement of the neural tissue requires CT or MRI. Myelography can sometimes be of value in providing information about which of several metastases is most probably symptomatic, if the clinical picture is obscure. Usually, a spinal block occurs at only one level.

It is also wise to bear in mind that multiple malignancies exist. One should not take for granted that a newly discovered metastasis comes from a previously known malignancy. Biopsy for a histopathological diagnosis should always be performed during surgery.

Indications and contraindications

The indications for operative treatment of spinal metastases go hand-in-hand with the goals of the treatment. The surgery should be of value to the patient in a wider perspective—from the patient's point of view, the cost of the surgical intervention in terms of risk of complications, convalescent time et cetera, should be motivated by a chance of reducing the symptoms and a reasonable time span during which the patient can benefit from this decrease.

A “spectrum of indications” can be defined. The lower limit is decided by the fact that the surgery is palliative and not curative. The patient must have symptoms from the metastasis at a certain level. Early in the course of a spinal metastasis, before a pathological fracture has evolved or a neurological threat is imminent, moderate pain does not justify a major operation. For most of these patients, radiotherapy is effective. However, severe pain, indicative of mechanical insufficiency or neurological dysfunction, constitutes an indication for operative treatment. The type of surgery is based on a detailed analysis of how the stability of the spine and the integrity of the neural structures are affected by the metastasis.

The upper limit of the indication spectrum is the criterion that the operation should be of value to the patient, who should not have to be convalescent for the rest of his or her life. The indication is thus governed by the expected survival of the patient. Patients with a very short expected survival time, or whose general health is too poor to tolerate surgery are excluded. It is also necessary to consider that different operative approaches entail different levels of morbidity during and after the operation. A small procedure with a less strenuous postoperative period (e.g., a cervical spine procedure) can be tolerated by a relatively weaker patient, whereas a large procedure (e.g., a total vertebrectomy involving both posterior and anterior surgery) requires a patient in relatively good general health.

A general rule is to perform “individualized surgery” (Sjöström et al. 1993). Each patient should be offered only the amount of surgery tolerated and should benefit by an increase in the quality of life. A patient with a long expected survival time may require a large operation to obtain a stabilization that

will last over time whereas a smaller operation will suffice in a patient with a shorter expected survival.

Neurological deterioration

The speed with which the neurological function deteriorates seems to correlate with the prognosis for recovery. A rapid neurological deterioration needs rapid decompression and stabilization, but if the neurological symptoms have developed over a longer period of time there is usually time to perform the necessary investigations and plan the operative procedure. A slower progression also seems to carry a better chance of neurological recovery. We believe that if a pathological fracture is associated with a rapid deterioration in neurological function, this may indicate a vascular complication with impending infarction of the nervous tissue. On the other hand, a slower deterioration in neurological function indicates an "irritation neuropraxia", which may be reversed when the compression is removed.

Steroids

Corticosteroids may be given to gain time in a neurologically critical situation. The mechanism for a rapid neurological deterioration in a pathological spinal fracture is probably similar to that in a traumatic spinal fracture. We have thus chosen to treat rapid neurological deterioration with the same steroid regimen as is recommended for traumatic spinal fractures with neurological damage (Bracken et al. 1990): methylprednisolone is given with an initial bolus of 30 mg per kilogram of body weight followed by an infusion at 5.4 mg kg⁻¹ h⁻¹ for 23 hours. The steroid scheme is initiated when the neurological damage is discovered and is discontinued without any descalation after 23 hours.

Acute treatment

The principles for the acute treatment differ depending on the neurological symptoms at presentation.

If the patient presents with normal or close to normal neurological function, the indication for operation is pain. There is usually plenty of time to investigate the patient and plan the operation thoroughly. There is no indication for steroid therapy. Since it is usually possible to achieve good pain control temporarily with pharmacotherapy, the operation can be scheduled at a convenient time.

A slow neurological deterioration—noted for several days or weeks—will probably continue in a slow

fashion. The recovery potential is good, although it may take a long time. In this subgroup of patients, there is, also usually plenty of time to perform the necessary investigations and to plan the procedure thoroughly. If the patient has good motor function (i.e., can walk or can lift the legs from the bed when lying down), there is no need for steroids. However, neurological examinations should be performed frequently to detect a deterioration that may require both steroids and an urgent operation.

Some patients experience a rapid neurological deterioration over hours or a few days. In this subgroup of patients, urgent decompression and stabilization may be the only measures that can save neurological function, but if the neurological damage is severe, the prognosis for recovery is poor. These patients are given methylprednisolone. Much time should not be spent on preoperative investigations to avoid postponing a necessary operation. Our present policy in these urgent cases is to obtain plain radiographs of the entire spine and at least one neuroradiologic investigation (CT, MRI or myelography) of the index area before surgery. If the primary tumor is unknown, there is usually no time to get a histological diagnosis. However, we strongly recommend an ultrasound or CT scan of the kidneys to rule out renal cancer, as these metastases should be embolized before surgery, even at the expense of postponing the operation a few hours, due to the severe bleeding problems that otherwise may be encountered (Olerud et al. 1993).

In patients with a total loss of neurological function, it is important to confirm this with great certainty. A patient will probably not recover if a total plegia has been present for more than 24 hours, but if the onset has been gradual, this time-limit may be extended somewhat. If there are questions about how long time a patient has been plegic, one can start methylprednisolone treatment and re-evaluate the patient in a few hours. If no neurological function still can be detected the indication to perform decompression and stabilization to save neurological function has ceased to exist. These patients are best treated non-operatively. However, there may still be an indication for operative stabilization because of severe pain.

Preoperative embolization

In renal cell carcinoma, the tumor tissue is highly vascularized and there is a substantial risk of massive blood loss during surgery. Preoperative embolization is performed in these patients, if the operation is expected to extend into the tumor tissue (Rowe et al. 1984, Waneck et al. 1989, Gellad et al. 1990).

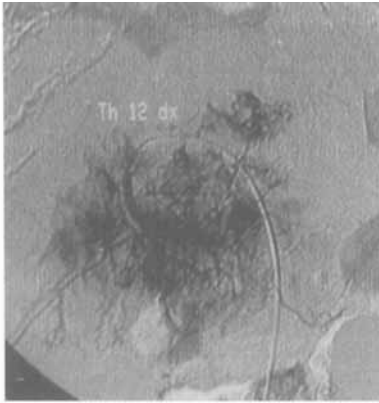


Figure 1a. A subtraction angiogram of a lumbar segment artery feeding a renal cell carcinoma metastasis. The metastasis is extremely well vascularized.



Figure 1b. After embolization of the metastasis most of the pathological vessels have been blocked. Surgery can now be performed with considerably less risk.

Angiography of the involved segmental arteries, as well as those above and below, is performed using a digital subtraction angiographic technique. After the main feeding vessels to the spinal cord have been ruled out at the current levels, the contributory arteries to the metastasis are embolized with particles of gelatine sponge (Spongostan™, Ferrosal, Denmark) or polyvinyl alcohol (Wet Filtered Ivalon™, Nycomed Ingenor, France) mixed with a contrast agent (Figure 1). The operation should be performed within 24 hours of the embolization to prevent recanalization of the tumor vessels.

We have evaluated the effect of embolization in a clinical study of 10 women and 11 men with a mean age of 63 (47–78) years, who were treated with a total of 29 operative procedures for thoracolumbar spinal renal cell carcinoma metastases. Preoperative embolization was performed prior to 11 operations and the 18 other operations served as controls (Olerud et al. 1993). At posterior surgery, the average blood loss was reduced to one third after embolization. The blood loss was also less during anterior surgery, although this difference was smaller (Table 1).

Specific treatment of spinal metastases

Indications and contraindications are general, regardless of the location of a metastasis in the spine. On the other hand, the surgical trauma, the postoperative morbidity, and the convalescence from cervical spine surgery is lower than that after spinal surgery at more caudal levels (Jónsson et al. 1994b). The specific symptom complexes and the principles for treatment also vary with respect to the spinal level.

Three typical patterns of spinal involvement of me-

tastases exist. Most spinal metastases develop close to the vertebral end-plates, where the bone becomes weakened and collapses. The intervertebral disks swell up with an increased water content and are pressed into the collapsing bone of the vertebral body. As the destruction of bone progresses, the vertebra loses its mechanical integrity and collapses. The posterior wall of the vertebral body will be pressed posteriorly into the spinal canal to compress the neural structures. Sometimes the tumor penetrates into the spinal canal and causes epidural growth. The mechanical forces result in a local kyphosis which increases the neural compression (Jónsson et al. 1994a, Petré-Mallmin 1994). The collapse secondary to a pathological fracture is comparable to that of a traumatic injury; it will cause severe pain and may jeopardize neural function.

More rarely, a metastasis develops in the posterior structures of the vertebra, the neural arch and articular processes. Destruction of the joints causes instability and pain. In this situation, the major deformity will be

Table 1. The effect of preoperative embolization on perioperative blood loss in litres for operative treatment of spinal metastases of renal cell carcinoma, mean SD

Embolization	Posterior procedure ^a		Anterior procedure ^b	
No	6.4	4.7	8.2	5.9
Yes	2.2	2.2	5.1	2.8

^a The posterior procedure entails decompression and transpedicular stabilisation via a posterior midline exposure.

^b The anterior procedure entails decompression and stabilisation via thoracotomy, thoracolumbotomy, or retroperitoneal exposure.

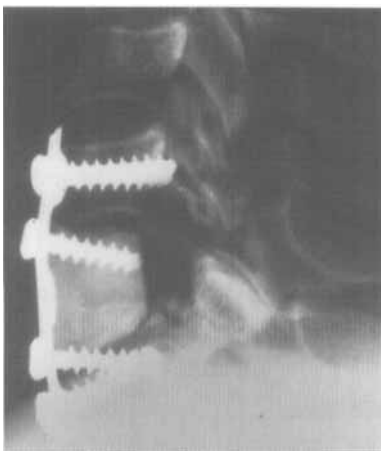


Figure 2. This patient has a metastasis to C6 which has been resected. The anterior pillar is reconstructed with methylmethacrylate cement and fixed with an H-plate.

translation, combined with kyphosis. Apart from being compressed in consequence of the deformity, the content of the spinal canal may in these cases also be compressed directly by the tumor which may extend into the epidural space.

A third mechanism for neurological impairment is the spinal stenosis which may occur secondary to hypertrophy of the bone itself. This phenomenon develops mainly in sclerotic metastases (i.e., prostate cancer) and seems to be caused by a direct stimulation of the osteoblasts (Galasko 1982, Bridwell 1991). Different combinations of these three types of spinal involvement may be seen in the same patient, even at the same level.

Cervical spine

Most cervical spine metastases are located in the vertebral body, which is progressively destroyed. In the typical case, a pathological fracture develops and the spine collapses into kyphosis. The compression of the spinal cord and nerve roots is caused partly by bone and tumor fragments bulging into the spinal canal and is partly secondary to the kyphotic deformity.

The symptoms in cervical metastases are dominated by pain, but neurological impairment is rarer and develops later than in the thoracic and lumbar region (Jónsson et al. 1994b). The neurological symptoms are usually minor and progression is slow. Tetraplegia secondary to a cervical spine metastasis is rare (Raycroft et al. 1978, Jónsson et al. 1994b).

In the cervical spine, it is usually best to decompress and stabilize from the front (Figure 2). Through the standard anterolateral approach, one can reach C1 to T1 (sometimes even T2). Decompression can easi-

ly be performed with curettes. Stability can be achieved with bone grafts or methylmethacrylate cement fixed with a metal plate (Clark et al. 1984, Jónsson et al. 1988, Sjöström et al. 1993). In exceptional cases with posterior involvement or intraspinal growth dorsal to the dura, decompression and stabilization can be performed from a posterior approach.

The anterior operation is performed with the patient supine in such a way that a C-arm image intensifier can be used for a lateral projection. The head rests in a head support and a skull traction of 3–4 kg is applied. The cervical spine is reduced to anatomical alignment. A standard left-sided anterolateral approach is used. With the spine exposed, the vertebral body can be resected. The posterior longitudinal ligament can usually be spared if the preoperative investigations have ruled out intraspinal tumor growth.

One of the aims is to obtain a stable fixation such that external neck supports can be avoided postoperatively. Various materials can be used for the reconstruction of the anterior column. The choice depends on the expected survival of the patient. If a patient is expected to live more than 1 year, it is advantageous to obtain a fusion healing; in these cases, the best option is to choose autologous bone. However, a commoner and simpler approach is to replace the resected vertebral body with methylmethacrylate cement. This is best injected into the defect after the fixation plate has been put in place. If the posterior longitudinal ligament is saved, there is usually no risk of the cement entering the spinal canal. The dura seems to tolerate the heat induced by the setting of the cement. In most patients, this reconstruction is satisfactory and will probably withstand fatigue for a few years. A great advantage with methylmethacrylate reconstruction is that the convalescent period is shortened. Morbidity from the graft site is also avoided. The fixation is immediate and is not dependent on bone healing that may be affected by postoperative radiotherapy.

In the event of a metastasis to the C2 vertebral body with a pathological dens fracture, we have developed a special technique (Figure 3). The tip of the dens is fixed with two intramedullary screws, the heads of which are imbedded in the methylmethacrylate replacement of the C2 vertebral body. The reconstruction is completed with a metal plate fixed to C3 and applied before the methylmethacrylate has set (Olerud 1982, Sjöström et al. 1990, Jónsson et al. 1994b).

Occasionally, a destruction of C2 involves one or both lateral masses (Figure 4). The axial support of the upper cervical spine is absent and therefore the previously mentioned technique cannot be used. For these patients we have developed an anterior technique where screws are placed in the arch and



Figure 3. In this patient, a metastasis has destroyed C2 and caused a pathological fracture of the dens. The reconstruction consists of screw fixation of the dens fragment, followed by filling of the defect in the C2 vertebral body with methylmethacrylate cement and connecting the cement to C3 with a plate and screws.

condyles of C1. The heads of these screws are then imbedded in methylmethacrylate cement which, as in the previous technique, is fixed to the lower cervical spine with a plate. If the condyle is intact on one side, the C1–C2 joint is transfixed with a screw inserted from the anterior aspect in the condyle of C2 and directed laterally and posteriorly.

Outcome

We have analyzed a prospective series of 51 consecutive patients treated for metastases in the cervical

spine (Jónsson et al. 1994b). Before the operation, all the patients suffered from severe pain in the neck, 21 had varying degrees of root pain, but only 6 were partly paretic due to myelopathy. In 37 patients, the metastasis was located in the vertebral body which had collapsed. The most common deformity was kyphosis but a few patients with posterior involvement also had translatory deformities. After the operation, all 51 patients experienced great relief of local pain. Of the 21 with root pain, 15 experienced total relief and 6 improvement to some extent. Of the 6 partly paretic patients, 5 regained their ability to walk.

Thoracic spine

Due to the relative narrowness of the spinal canal and the delicate vascular supply to the spinal cord in this area, neurological dysfunction appears early in the course of a thoracic spinal metastasis. The paresis, however, is usually preceded by a few weeks of increasing pain which is usually felt between the shoulder blades and often combined with radiating pain circumferentially around the trunk. The neurological symptoms can mimic various traumatic partial spinal cord injury patterns.

In the case of a lytic metastasis with a collapse of the vertebral body, a kyphotic deformity and compression of the spinal cord from the front by the bulging posterior vertebral body wall, it is seldom necessary to resect the metastasis from the front. 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 (Olerud et al. 1992) (Figure 5). The reduced spine is then stabilized with a neutralizing fixation device. The procedure can easily be done from a pos-



Figure 4a. Metastasis to the C2. The patient suffers from severe pain, but no neurological symptoms are present.



Figure 4b. CT reconstruction in a frontal plane. The metastatic destruction involves the lateral mass of C2 with insufficient axial support.



Figure 4c. Retention screws have been inserted into the anterior arch and the condyles of C1 and are imbedded in the methyl methacrylate cement. The cement is secured to the lower cervical spine with a plate.



Figure 5a. Preoperative myelography of a lytic metastasis to Th9 which bulges into the spinal canal and causes pain and neurological impairment. The compression is exaggerated by the kyphotic deformity over the segment.



Figure 5b. Intraoperative myelography of the same patient after realignment of the spine. Note that the anterior compression is effectively removed.



Figure 6. A lytic thoracic metastasis which has been reduced and stabilized with the PF device via a rather small posterior procedure. The fixation will usually withstand fatigue-destruction for a few years which in most patients is sufficient.

terior approach, where a secure fixation can be achieved with pedicular screws (Karlström et al. 1988, Olerud et al. 1988, 1992, Thalgott et al. 1988, Sjöström et al. 1993). For this purpose, we use the PF device of the Olerud Spinal System (NordOpedic AB, Länna, Sweden) (Figure 6). Via the posterior approach, intraspinal tumors can be removed, tumor-infiltrated pedicles can be resected, and the surgeon can usually reach around the dura to some degree to improve anterior decompression (Magerl and Coscica 1988).

Some patients have multiple thoracic metastases or metastases involving several adjacent vertebrae requiring multi-segment fixation systems. Any 3rd generation scoliosis device can be used (e.g., CD, ISO-LA, USS et cetera). However, the larger exposure means greater surgical trauma, postoperative morbidity and a longer convalescence than when a shorter fixation is used. This must be taken into consideration in planning the surgery. With these devices, the cost also increases significantly.

For the patient, it is probably less onerous to undergo posterior surgery than anterior, where a thoracotomy or thoracolumbotomy is required. The decompression is usually satisfactory and the stabilization provided by a transpedicular device is quite sufficient and probably better than the results achieved from the anterior approach. The greatest disadvantage with the posterior approach is that it is usually not possible to reconstruct an anterior support. Presently, there is no simple technique available where the defective anterior column can be reconstructed from a posterior approach. The transpedicular fixation device, which will be load-bearing but not load-sharing, will be subjected to fatigue and eventually loosen or break. However, experience has taught us that the fixation will give a clinically satisfactory result for between 1 and 2 years. This may seem short but it exceeds the life expectancy of most patients.

For the few patients with an expected survival of more than one year, a reconstruction of the anterior column is necessary. Preferably, this can be performed as an elective procedure with the patient in optimal condition within a few weeks after the primary operation (Jónsson et al. 1992b). The anterior reconstruction can be performed with various materials. The simplest technique is to fill the defect with meth-



Figure 7. Since this patient with a metastasis to the thoracolumbar junction was estimated to survive for several years, a secondary anterior pillar reconstruction was performed. In this particular patient, methylmethacrylate cement was utilized.

ylmethacrylate (Figure 7). Other options are to use autologous or allogous bone. In a patient with a good prognosis as regards long-time survival, we recommend autologous fibula, which leads to a reliable anterior fusion with a minimum of graft site morbidity. Recently we have started to do this with a thoracoscopic technique, which is promising. The surgical trauma is reduced with this “minimally invasive surgery” and an anterior column reconstruction may be possible even in patients with more advanced disease.

Lumbar spine

The greatest clinical difference between the thoracic and lumbar spine is the neurological symptom pattern. In the lumbar spine below L1, a metastasis may result in a flaccid paresis due to compression of the cauda equina. Sensibility disturbances follow dermatomes and all modalities are affected. The sphincters may be affected in various ways. Metastases in the vicinity of the conus medullaris may produce symptoms which are a mixture of those from the cauda equina and medulla.

The principles for treatment of lumbar metastases resemble those employed for the treatment of thoracic

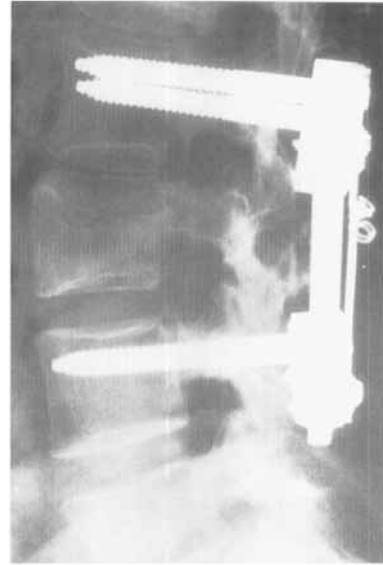


Figure 8. A lytic metastasis to L3 treated with the posterior approach. In this patient an anterior resection would have been a considerably larger procedure. An other advantage of the posterior approach is that an intraspinal tumor can be resected through the same approach.

lesions (Figure 8). Posterior surgery is primarily chosen with indirect decompression via realignment and reduction, resection of the intraspinal tumor via laminectomy, and resection of the affected pedicles. As in the thoracic spine, for the patient with a good survival prognosis, a secondary anterior reconstruction is performed as a planned procedure within a few weeks of the first operation.

Outcome

The outcomes of the treatment of thoracic and lumbar spinal metastases are taken from a prospective series of 51 consecutive patients treated in our department (Jónsson et al. 1996). 37 of the lesions were in the thoracic spine and 14 in the lumbar. 32 of the patients were men and 19 were women, aged 64 (33–85) years. Carcinomas of the prostate were commonest (Table 2). All 51 patients had severe pain or neurological dysfunction. Before treatment, 26 of the patients were ambulatory, while 25 were paretic.

The patients were treated according to the principles previously described. Postoperatively, they were monitored at 3-month intervals. Pain was recorded on a visual analogue scale. Functional performance was measured using the 1–5 scale Eastern Co-Operative Oncology Group Performance Scoring Scale (Verger et al. 1992). The patient’s living conditions—i.e., own home or institution—were also recorded.

The treatment had a very good effect on pain and

Table 2. The distribution of tumor types of 51 consecutive, thoracolumbar spine metastases

Tumor type	Number
Prostate	21
Breast	9
Kidney	8
Lung	4
Myeloma	3
Misc.	6

Table 3. Pain, functional performance and survival after operative treatment of thoracolumbar spinal metastases in 51 patients

Months after the operation	Pain ^a	Independence ^b No. / No. still alive	Dead No.	Survival ^c (%)
0	7	8 / 51	0	100
3	2	19 / 42	9	80
6	—	19 / 32	19	65
9	—	16 / 25	26	—
12	—	13 / 24	27	45
18	—	10 / 14	37	—

^a mean VAS: visual analogue scale, graded from 0 to 10.

^b Eastern Co-Operative Oncology Group Performance Scoring Scale > 2.

^c Kaplan-Meier.

Table 4. Walking ability before and after operative treatment of thoracolumbar spinal metastases

	Walkers	Non-walkers
Preoperative	26	25
Postoperative	45	6

functional performance. 19 of the 25 paretic patients regained their ability to walk. Of the total series, 2/3 could be discharged to their own home and only 1/3 required further institutionalized treatment (Tables 3 and 4).

Conclusion

Patients with spinal metastases not only find themselves with a chronic disease which is likely to be fatal within a short period of time. They also suffer the agony and disability caused by the condition. By applying modern radiographic and surgical techniques we can offer the vast majority of these patients good and lasting palliation in terms of pain relief, retained

walking ability, and independent living. From an ethical point of view it is our duty, to help them with this if at all possible.

The treatment is probably also cost-effective. We calculated the costs for the health care system directly related to preoperative investigations, surgery, and perioperative care with the outcome we had seen in our series. This cost was substantially lower than the estimated cost of the institutional care that would have been necessary if no surgery had been undertaken (Jónsson et al. 1992a).

Editor's note

The number of operations for spinal metastases has increased because of new technologies, notably stabilization of the spine, and an increasing number of patients in a reasonably good condition, despite spinal metastases, thanks to improved oncological care. The optimum number of patients with spinal metastases who should be operated on is unknown. The numbers of patients requiring surgery for spinal metastases seem to be the same in different parts of Sweden; the annual incidence in Lund, southern Sweden, is 50/1.5 mill inhabitants. Most of these patients are referred as emergency cases because of increasing neurological symptoms.

In addition to these guidelines from Uppsala, treatment protocols have also been published from Lund (Onkologiskt centrum för södra sjukvårdsregionen 1992, Strömqvist et al. 1996) and Stockholm (Onkologiskt centrum Stockholm-Gotland 1995), Sweden.

References

- Bauer H C F, Wedin R. Survival after surgery for spinal and extremity metastases. Prognostication in 241 patients. *Acta Orthop Scand* 1995; 66: 143-6.
- Bracken M B, Shepard M J, Collins W F, Holford T R, Young W, Baskin D S, Eisenberg H M, Flamm E S, Leo L S, Maroon J, Marshall L F, Perot P L, Piepmeier J, Sonntag V K H, Wagner F C, Wilberger J E, Winn R H. A randomized, controlled trial of methylprednisolone or naloxone in the treatment of acute spinal cord injury. Results of the second national acute spinal cord injury study. *N Engl J Med* 1990; 322: 1405-11.
- Bridwell K. Treatment of metastatic prostate cancer of the spine. *Urol Clin North Am* 1991; 18: 153-9.
- Clark C R, Keggi K J, Panjabi M M. Methylmethacrylate stabilization of the cervical spine. *J Bone Joint Surg (Am)* 1984; 66: 40-6.
- Denis F. The three column spine and its significance in the classification of acute thoracolumbar spinal injuries. *Spine* 1983; 8: 817-31.
- DeWald R L, Bridwell K H, Prodromos C, Rodts M F. Reconstructive spinal surgery as palliation for metastatic malignancies of the spine. *Spine* 1985; 10: 21-6.

- Fidler M. Pathological fractures of the cervical spine. Palliative surgical treatment *J Bone Joint Surg (Br)* 1985; 67: 352-7.
- Galasko C. Mechanism of lytic and blastic metastatic disease of bone. *Mech Metast* 1982; 169: 20-7.
- Galasko C. Spinal instability secondary to metastatic cancer. *J Bone Joint Surg (Br)* 1991; 73: 104-8.
- Gellad F E, Sadato N, Numaguchi Y, Levine A M. Vascular metastatic lesions of the spine: preoperative embolization. *Radiology* 1990; 176: 683-6.
- Hendrickson F R, Sheinkop M B. Management of osseous metastases. *Semin Oncol* 1975; 2: 399-404.
- Jaffe H. Tumors and tumorous conditions of the bones and joints. Lea & Febiger, Philadelphia 1958: 589-613.
- Jónsson B, Jónsson H Jr, Olerud C, Sjöström L, Andersen S, Karlström G. Kirurgisk behandling av ryggmetastaser—Kostnadsanalys. Svenska Läkaresällskapets Riksstämma 25-27 november 1992a.
- Jónsson B, Sjöström L, Jonsson H, Karlström G. Surgery for multiple myeloma of the spine. *Acta Orthop Scand* 1992b; 63: 192-4.
- Jónsson B, Jónsson H, Karlström G, Sjöström L. Surgery of cervical spine metastases: a retrospective study. *Eur Spine J* 1994a; 3: 76-83.
- Jónsson B, Petrén-Mallmin M, Jónsson H, Andréasson I, Rauschnig W. Pathoanatomical and radiographic findings in spinal breast cancer metastases. *J Spinal Dis* 1994b; 8: 26-38.
- Jónsson B, Sjöström L, Olerud C, Andréasson I, Bring J, Rauschnig W. Outcome after limited posterior surgery for thoracic and lumbar spine metastases. *Eur Spine J* 1996; 5: 36-44.
- Jónsson H, Sjöström L, Karlström G, Olerud S. Internal stabilization of pathological fractures in the cervical spine. *Acta Orthop Scand* 1988; 59: 91-2.
- Karlström G, Olerud S, Sjöström L. Transpedicular segment fixation; description of a new procedure. *Orthopedics* 1988; 11: 689-700.
- Kostuik J P, Weinstein J. Differential diagnosis and surgical treatment of metastatic spine tumors. The adult spine. Principles and practice. J W Frymoyer, Raven Press Ltd, New York 1991.
- Magerl F, Coscica M. Total posterior vertebratomy of the thoracic or lumbar spine. *Clin Orthop* 1988; 232: 62-9.
- Olerud S. Ortopedisk stabiliseringsteknik av halskotpelare. *Läkartidningen* 1982; 79: 662.
- Olerud S, Karlström G, Sjöström L. Transpedicular fixation of thoracolumbar vertebral fractures. *Clin Orthop* 1988; 227: 44-51.
- Olerud C, Sjöström L, Jónsson H Jr, Karlström G. Posterior reduction of a pathologic spinal fracture. A case of indirect anterior dural decompression. *Acta Orthop Scand* 1992; 63: 345-6.
- Olerud C, Jónsson H Jr, Löfberg A L, Lörelius L E, Sjöström L. Embolization of spinal metastases reduces perioperative blood loss. 21 patients operated for renal cell carcinoma. *Acta Orthop Scand* 1993; 64: 9-12.
- Onimus M, Schraub S, Bertin D, Bosset J F, Guidet M. Surgical treatment of vertebral metastasis. *Spine* 1986; 11: 883-91.
- Onkologiskt centrum Stockholm-Gotland. Skelettmetastaser. Diagnostik, behandling och uppföljning i Stockholm-Gotland regionen. 1995.
- Onkologiskt centrum för södra sjukvårdsregionen. Vårdprogram för medullakompression orsakad av maligna tumörer. 1992.
- Petrén-Mallmin M. Cinical and experimental imaging of breast cancer metastases in the spine. Doctoral Thesis at Uppsala University 1994 from the Department of Diagnostic Radiology. Munksgaard, Copenhagen.
- Raycroft J F, Hockman R P, Southwick W O. Metastatic tumors involving the cervical vertebra. Surgical palliation. *J Bone Joint Surg (Am)* 1978; 60: 763-8.
- Rowe D M, Becker G J, Rabe F E, Holden R W, Richmond B D, Wass J L, Sequeira F W. Osseous metastases from renal cell carcinoma: embolization and surgery for restoration of function. *Radiology* 1984; 150: 673-6.
- Siegel T, Siegal S. Current considerations in the management of neoplastic spinal cord compression. *Spine* 1989; 14: 223-8.
- Sjöström L, Olerud S, Karlström G, Hamberg H, Jónsson H. Anterior stabilization of pathologic dens fractures *Acta Orthop Scand* 1990; 61: 391-3.
- Sjöström L, Jónsson H, Karlström G, Olerud C, Olerud S. Surgical treatment of vertebral metastases. *Contemp Orthop* 1993; 26: 247-55.
- Strömqvist B, Johnsson R, Nilsson J. 98 consecutive thoracolumbar spine metastases with symptomatic cord or root compression—outcome of posterior spine surgery. *Acta Orthop Scand (Suppl 270)* 1996: 61-2.
- Thalgott J S, Aebi M, LaRocca H. Internal spinal skeletal fixation system. *Orthopedics* 1988; 11: 1465-8.
- Tokuhashi Y, Matsuzaki H, Toriyama S, Kawano H, Ohsaka S. Scoring system for the preoperative evaluation of metastatic spine tumor prognosis. *Spine* 1990; 11: 1110-3.
- Verger E, Salamero M, Conill C. Can Karnofsky performance status be transformed to the Eastern Co-Operative Oncology Group scoring scale and vice versa? *Eur J Cancer* 1992; 28: 1328-30.
- Wanek R, Jantsch H S, Karmel F, Lechner G. Embolisationen von Knochenmetastasen. *Hämostaselogie* 1989; 9: 37-43.