Decompression/stabilization of the metastatic spine

Cotrel-Dubousset-Instrumentation in 50 patients

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50 patients with metastatic disease of the spine underwent dorsal decompression and stabilization with the Cotrel-Dubousset-Instrumentation from 1987 to 1991. Indications for surgical treatment were neurologic deficit, spinal instability, and/or pain resistant to medical or radiation treatment. No external orthotics were used postoperatively. Pain was relieved dramatically in 45 patients. Among 25 patients suffering from neurologic deficit preoperatively, 13 improved, 15 remained unchanged, whereas 2 developed an incomplete, transient paraplegia. 15 (7) patients were alive after 1 (2) years. Postoperative complications were frequent, but there were only 2 failures of the stabilization device requiring reoperation.

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Standard treatment for neurologic deficit in metastatic spinal disease has been posterior decompression. However, in the majority of cases the cord is compressed by anteriorly-located tumor tissue, and, perhaps importantly, by a gibbous formation caused by destruction and compression of the vertebral body (Siegal and Siegal 1989, Asdourian et al. 1990, Galasko 1991). Hence, posterior decompression often increased spinal instability without decompressing the cord, and the results were poor. During recent years, anterior decompression and stabilization has instead become increasingly used, often leading to a dramatic reduction of pain and re-establishment of neurologic function, including ambulation (Fidler 1986, Harrington 1988).

Anterior decompression and stabilization is, however, resource consuming and associated with a high morbidity (Moore and Utley 1989). Posterior decompression has again been applied but now combined with stabilization of the spine and even reduction of the gibbus through posterior spinal instrumentation (Perrin and McBroom 1988, Olerud et al. 1992). We report 50 consecutive patients with spinal metastases treated by posterior decompression and stabilization with the Cotrel-Dubousset-Instrumentation (CDI; Cotrel et al. 1988).

Patients and methods

The study was based on 50 patients with spinal metastatic disease treated surgically 1987–91 (Table 1). There were 23 women and 27 men with a mean age of 61 (30–85) years. The most common primary tumors were cancer of the breast, prostate and lung; 1 patient had an unknown primary malignancy. The majority of metastatic lesions were located in the lower thoracic and upper lumbar spine (Table 2). 21 patients had only a single vertebral involvement, whereas 29 suffered from multi-level metastatic disease.

The preoperative clinical evaluation assessed the overall state of the metastatic disease, life expectancy, pain, and neurologic deficit. Surgical indications were pain resistant to medical or radiation treatment and/or neurologic dysfunction. 25 patients had neurologic dysfunction according to the score of Frankel et al. (1969), 15 of whom had major motor weakness.

Preoperative radiologic examinations aimed at assessing spinal destruction, instability, and cord compression. The studies included plain radiographs, and bone scintigraphy. Since 1990, MRI has been used routinely permitting longitudinal projection of tumor expansion and cord compression, and obviating myelography in most instances.

52 spondylodeses with CDI were performed in 50 patients (Figures 1 and 2). All levels which had been diagnosed to be endangered by dural impingement were decompressed posteriorly. If technically practicable, hooks were implanted two levels above and below

Table 1. Observations in 50 patients operated on for spinal metastases by posterior decompression and stabilization

A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	1	50	6	1	2	Th4	Th6	1	D	D		5	B
2	2	51	1	1	7	Th10	L5	1	D	D	D	19	B
3	2	72	12	1	10	T7	S	3	E	E		17	A
4	2	73	4	2	5	Th10	L3	2	C	D		14	A
5	2	45	1	4	8	C6	Th7	2	E	E		9	B
6	1	60	6	4	8	Th7	L3	2	E	E		13	A
7	1	52	2	1	2	L3	L5	1	E	E		10	A
8	1	57	8	2	4	Th12	L4	1	E	E		19	B
9	2	69	3	1	4	C1	C5	1	E	E		8	B
10	2	72	1	2	5	Th4	Th9	2	C	E		7	A
11	2	48	1	1	4	L1	L5	1	E	E		5	A
12	1	66	2	1	14	Th3	L5	1	D	E	B	27	A
13	1	60	3	6	10	Th7	L5	3	C	D		9	B
14	1	85	9	1	4	Th4	Th8	1	E	E		2	B
15	1	57	5	1	5	Th6	Th11	1	C	C		2	B
16	2	55	1	13	8	Th9	L5	3	E	E		10	A
17	1	48	8	1	2	Th7	Th9	1	A	A		1	B
18	1	52	5	1	5	Th5	Th10	1	E	E		52	A
19	2	50	5	5	9	Th8	L5	5	A	C		27	B
20	2	56	3	1	5	Th11	L4	1	E	E		2	B
21	1	64	4	4	7	Th4	Th11	3	C	E		51	A
22	2	75	14	5	12	Th5	L5	3	D	B		9	B
23	2	51	1	3	6	Th8	L2	3	E	E		7	A
24	2	55	1	1	2	Th10	Th12	1	E	E	A	19	B
25	2	71	4	5	6	Th9	L3	3	E	E		6	A
26	1	30	11	1	2	Th12	L2	1	B	B		7	B
27	1	66	13	4	6	Th9	L3	2	E	E		1	B
28	2	62	1	4	12	Th4	L4	4	E	E		5	B
29	2	57	1	4	8	C7	Th8	2	E	E		9	A
30	1	68	9	3	7	Th9	L4	1	D	D		7	B
31	2	62	1	2	4	Th10	L2	1	D	C	B,D	17	B
32	2	60	1,7	1	4	C3	C7	1	D	D	A	16	B
33	2	53	6	2	4	Th12	L4	1	E	E		13	A
34	1	68	3	1	5	Th4	Th9	2	B	C	A	13	B
35	1	72	10	1	5	Th9	L2	2	E	E		13	B
36	2	42	1	3	12	C7	Th12	3	C	D		8	B
37	2	61	4	2	4	L1	L5	1	D	D		19	A
38	1	73	5	4	11	Th6	L5	4	B	D		2	B
39	1	60	2	1	5	Th12	L5	1	D	E		8	A
40	1	61	2	6	2	L3	L5	1	C	C		19	B
41	1	69	6	2	4	C6	Th3	1	E	E	C	13	B
42	1	67	4	5	6	Th9	L3	1	E	E		14	A
43	2	56	7	1	5	Th12	L5	1	A	C		19	A
44	2	80	7	1	2	L2	L4	1	A	A	C	6	B
45	1	77	2	2	5	Th12	L5	3	C	D		2	B
46	1	55	3	6	12	Th2	L2	2	E	E	A,B	27	B
47	1	68	3	1	4	L1	L5	1	E	E		12	B
48	1	70	2	3	10	Th3	L2	3	E	E		16	A
49	1	64	2	4	6	Th11	L5	4	D	E		9	A
50	1	60	4	6	12	Th2	L2	7	C	D		6	A

A Case
B Sex
 1 male
 2 female
C Age at operation
D Primary malignancy
 1 breast
 2 prostate
 3 lung
 4 myeloma
 5 non-Hodgkins lymphoma
 6 kidney
 7 uterus
 8 larynx
 9 parotis
 10 bladder
 11 testicle
 12 thyroid
 13 pancreas
 14 unidentified

E Number of vertebrae affected
F Number of stabilized spinal segments
G Upper spinal segment stabilized
H Lower spinal segment stabilized
I Number of decompressed spinal segments
J Preoperative evaluation of neurologic deficit according to Frankel et al. 1969
 A Complete, no motor, sensory, or sphincteric function below the lesion of the cord
 B Sensory only, i.e., some sensation but no motor function
 C Motor function useless, i.e.,some motor power present below the lesion but of no practical use
 D Motor function useful, i.e., could walk, with or without aids
 E Recovery, i.e., free of neurologic symptoms

K Postoperative evaluation of neurologic deficit
 see J
L Complications
 A pulmonary
 B deep venous thrombosis
 C infection
 D hook dislocation
M Last follow-up
 (months after operation)
N Status at last follow-up
 A alive
 B dead

Table 2. Distribution of 3 cervical, 79 thoracic, and 56 lumbar metastases

Level	Number of vertebrae
C3	2
C5	1
Th1	3
Th2	1
Th3	3
Th4	2
Th5	4
Th6	4
Th7	8
Th8	6
Th9	6
Th10	6
Th11	13
Th12	23
L1	21
L2	15
L3	9
L4	8
L5	3

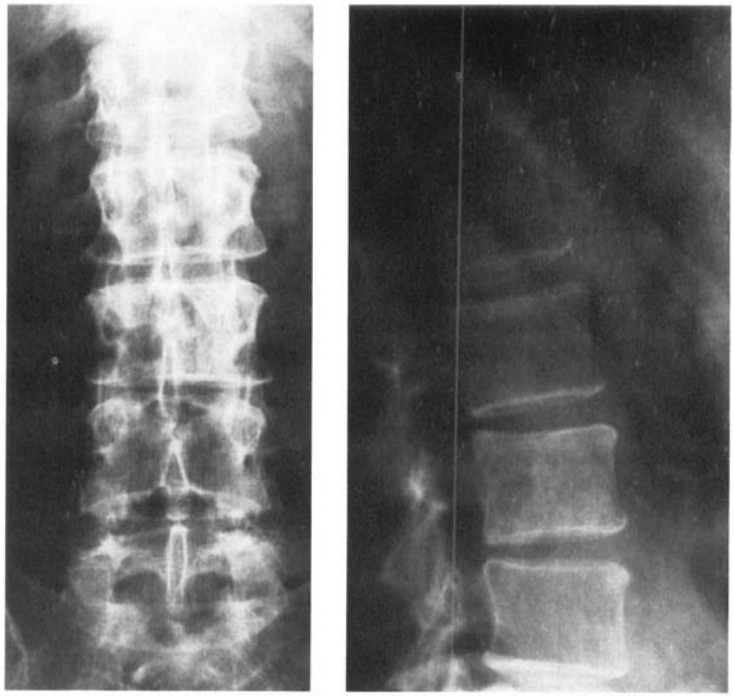
the specific lesion, being connected through pre-bent rods on either side of the spine. The range of fusion comprised a mean of 6 (2–14) segments. The mean operating time was 220 (70–650) minutes and the mean peroperative blood loss was 1.9 (0.3–4.6) L. Excessive bleeding was often encountered in metastases from kidney cancer, mean 3.2 L.

Complications

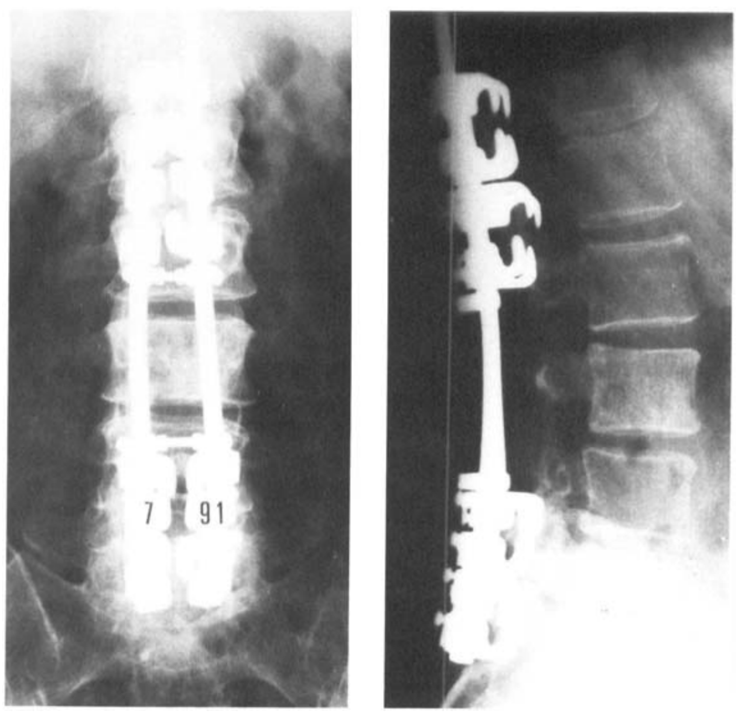
Complications were frequent in the immediate postoperative period. There were 4 pulmonary infections, 3 deep vein thromboses of the lower leg, and 2 patients had stress ulcer bleeding requiring surgical intervention. Wound healing was protracted in 2 patients who had been exposed to radiotherapy before spinal surgery. Pressure sores developed in 2 paraplegic patients.

Progression of the osseous destruction led to displacement of the hook fixation at the thoracolumbar junction in 2 patients, reoperated by extension of the segmental stabilization.

Figure 1. Case 39. 60-year-old man with metastasis of prostate cancer.

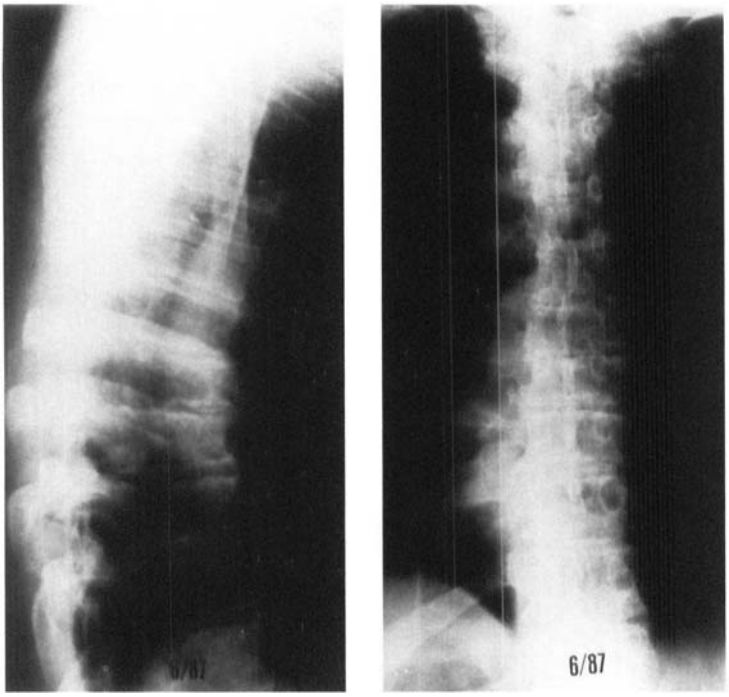


Metastasis to the L3 vertebra with cord compression leading to neurologic deficit Frankel Grade C.

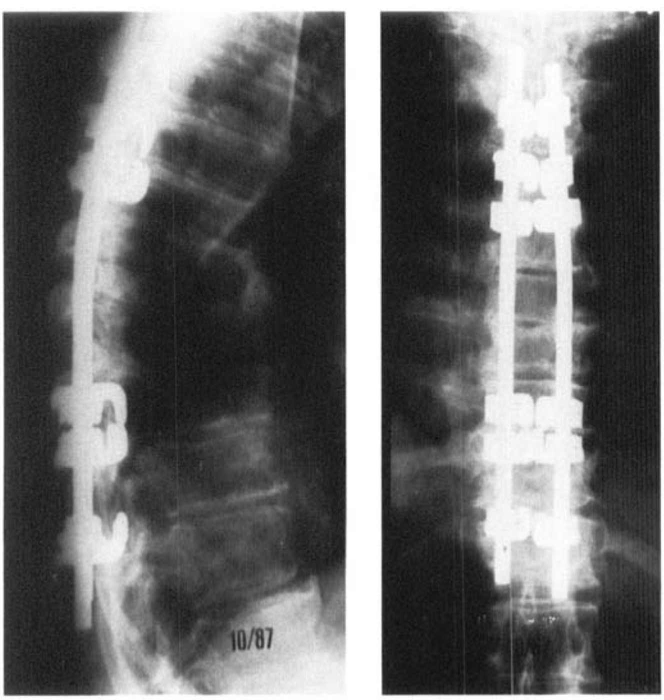


Treated with posterior decompression of the encircled spinal cord an CDI stabilization from L1 to L5 resulted in complete restoration of neurologic function and pain relief.

Figure 2. Case 21. 64-year-old man with plasmacytoma.



Radiographs revealed compression fractures of the 6th to the 9th thoracic vertebra.



After laminectomy of the 4 vertebrae, posterior spondylodesis from the 4th to the 11th vertebra was performed with the CDI.

Results

Assessment of postoperative survival rates by life-table technique was based on the first 40 patients with a minimum follow-up of 12 months (Figure 3). 23 patients were alive at 1 year and 7 at 2 years. Pain was relieved dramatically in 45 of the 50 patients. In 5 patients severe pain persisted, all of whom presented with extensive metastases and all died within 3 months of surgery.

Regarding the neurologic deficit, 10 out of 15 patients with Frankel neurologic Grades A–C were improved, and ambulation was regained in 7 (Table 3). The best results were obtained among the 8 patients with Grade C neurologic deficits, 6 of whom were able to walk postoperatively. A deterioration of neurologic function was observed in 2 of the 10 Grade D patients; postoperatively 1 was Grade B and the other Grade C. In neither case could postoperative CT provide information about the cause. Nevertheless, the patients were pain-free, and follow-up revealed the re-establishment of preoperative neurologic function within 3 months.

Discussion

A notable transition in the treatment strategy of spinal metastases has taken place in the past two decades. The improved results acquired after anterior decompression and spinal stabilization have expanded the indications for surgery. However, controversy still exists regarding the indications for surgical management, and the operative approach to achieve decompression and stabilization of sufficient durability to outlive the patient, with a minimal risk of per- and postoperative complications (Lee et al. 1986, Sundaresan et al.

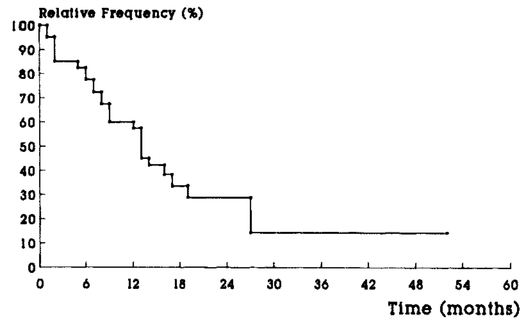


Figure 3. Postoperative survival assessed by life-table technique for the first 40 patients with a minimum follow-up of 12 months.

Table 3. Pre- and postoperative neurologic grade according to Frankel et al. (1969) in 50 patients treated for spinal metastases. For key, see legend to Table 1 J

	Postoperative				
	A	B	C	D	E
A	2	–	2	–	–
B	–	1	1	1	–
C	–	–	2	4	2
D	–	1	1	5	3
E	–	–	–	–	25

1986, Harrington 1988, Siegal and Siegal 1989).

Since 8 out of 10 epidural tumors arise from the vertebral body and afflict the spinal cord from the front, an anterior approach has become the recommended procedure permitting direct access to the tumor, facilitating extirpation of tumorous tissue to achieve decompression of compromised neurological structures, and enabling re-establishment of segmental stability (Fidler 1986, Harrington 1988, Kostuik et al. 1988, O'Neil et al. 1988, Manabe et al. 1989). However, these reports were mainly based on patients presenting with neurologic deficiencies as a result of single-level tumorous compression of the spinal cord, and most operations were performed for decompression. A wide resection of the cancerous infiltration was not feasible, making adjuvant oncologic therapy as necessary as after posterior decompression and stabilization. Furthermore, postoperative external support was necessary for most patients (Sundaresan et al. 1990). In our series, the indications for surgery in the majority of patients was pain due to multi-level vertebral involvement with none or only slight neurologic deficit. Furthermore, in those with neurologic deficit, the anterior cord impingement was secondary to single or multi-level collapse of vertebral bodies rather than to direct compression by tumor masses (Perrin and McBroom 1988, Galasko 1991). In this selected group of patients, an anterior approach offers no advantages compared to the posterior exposure, which is associated with considerably less morbidity. Furthermore, indirect reduction of vertebral collapse and posterior stabilization may achieve anterior decompression, as in the treatment of burst fractures (Galasko 1991, Olerud et al. 1992).

In our opinion, the anterior approach should be reserved only for patients who suffer from tumorous damage to bone and/or cord confined to a single vertebra and in whom anterior instrumentation alone should be sufficient to provide solid reconstruction of the vertebral column, without external support.

Our mainstay in the posterior intervention is the highly adaptable CDI developed by Cotrel and Dubousset in the early 1980s aiming at rigid spondylodesis without sublaminar wiring, and making external postoperative support unnecessary (Cotrel et al. 1988). Although designed for scoliotic deformities, its application soon expanded to traumatic and pathological fractures of the spine, after several investigators had pointed out the relative superiority of segmental spinal instrumentation for flexion and rotation loading, as compared to either Harrington or Luque conventional distraction techniques (Sullivan and Conner 1982, McAfee et al. 1985, Haid et al. 1990). In our experience, hook fixation at several levels provides excellent stability, even in the presence of subtotal destruction of the affected vertebrae together with disintegration of the spinal profile, even in cases of postlaminectomy instability (Gurr and McAfee 1988). Nevertheless, we were confronted with two hook dislocations at the thoraco-lumbar junction, where bridging of the kyphotic deformity caused increased stress to the most proximal and distal laminae already weakened by tumor. We now apply, if technically possible, hooks two levels above and below the region of instability, a configuration that we think combines sufficient stabilization with a short span of the spondylodesis.

References

Asdourian P L, Mardjetko S, Rauschning W, Jonsson H Jr, Hammerberg K W, Dewald R L. An evaluation of spinal deformity in metastatic breast cancer. J Spinal Disord 1990; 3 (2): 119–34.

Cotrel Y, Dubousset J, Guillaumat M. New universal instrumentation in spinal surgery. Clin Orthop 1988; 227: 10–23.

Fidler M W. Anterior decompression and stabilisation of metastatic spinal fractures. J Bone Joint Surg (Br) 1986; 68 (1): 83–90.

Frankel H L, Hancock D O, Hyslop G, Melzak J, Michaelis L S, Ungar G H, Vernon J D, Walsh J J. The value of postural reduction in the initial management of closed injuries of the spine with paraplegia and tetraplegia. I. Paraplegia 1969; 7 (3): 179–92.

Galasko C S. Spinal instability secondary to metastatic cancer. J Bone Joint Surg (Br) 1991; 73 (1): 104–8.

Gurr K R, McAfee P C. Cotrel Dubousset instrumentation in adults. A preliminary report. Spine 1988; 13 (5): 510–20.

Haid R W, Carter R L, Macmillan M. Cotrel Dubousset instrumentation for spinal neoplasms. J Neurosurg 1990; 72: 350.

Harrington K D. Anterior decompression and stabilization of the spine as a treatment for vertebral collapse and spinal cord compression from metastatic malignancy. Clin Orthop 1988; 233: 177–97.

Kostuik J P, Errico T J, Gleason T F, Errico C C. Spinal stabilization of vertebral column tumors. Spine 1988; 13 (3): 250–6.

Lee C K, Rosa R, Fernand R. Surgical treatment of tumors of the spine. Spine 1986; 11 (3): 201–8.

Manabe S, Tateishi A, Abe M, Ohno T. Surgical treatment of metastatic tumors of the spine. Spine 1989; 14 (1): 41–7.

McAfee P C, Werner F W, Glisson R R. A biomechanical analysis of spinal instrumentation systems in thoracolumbar fractures. Comparison of traditional Harrington distraction instrumentation with segmental spinal instrumentation. Spine 1985; 10 (3): 204–17.

Moore A J, Uttley D. Anterior decompression and stabilization of the spine in malignant disease. Neurosurgery 1989; 24 (5): 713–7.

O'Neil J, Gardner V, Armstrong G. Treatment of tumors of the thoracic and lumbar spinal column. Clin Orthop 1988; 227: 103–12.

Olerud C, Sjöström L, Jonsson H Jr, Karlström G. Posterior reduction of a pathologic spinal fracture. A case of indirect anterior dural decompression. Acta Orthop Scand 1992; 63 (3): 345–6.

Perrin R G, McBroom R J. Anterior versus posterior decompression for symptomatic spinal metastasis. Can J Neurol Sci 1988; 14 (1): 75–80.

Siegal T, Siegal T. Current considerations in the management of neoplastic spinal cord compression. Spine 1989; 14 (2): 223–8.

Sullivan J A, Conner S B. Comparison of Harrington instrumentation and segmental spinal instrumentation in the management of neuromuscular spinal deformity. Spine 1982; 7 (3): 299–304.

Sundaresan N, Digiacinto G V, Hughes J E. Surgical treatment of spinal metastases. Clin Neurosurg 1986; 33: 503–22.

Sundaresan N, Krol G, Digiacinto G, Hughes J E O. Metastatic tumours of the spine. In: Tumours of the Spine (Eds. Sundaresan, N, Schmidek, H. H, Schiller, A. D, Rosenthal, D. I.) Saunders, Philadelphia 1990: 279–304.