Posterior Decompression and Stabilization for Metastatic Spine Diseases

Lih-Huei Chen, MD; Chi-Chien Niu, MD; Tsai-Sheng Fu, MD; Po-Liang Lai, MD; Chak-Bor Wong, MD; Wen-Jer Chen, MD

Background: The purpose of this study was to investigate the clinical results of posterior decompression and stabilization for metastatic diseases of the thoracolumbar spine.

Methods: From 1980 to 2001, 70 consecutive patients with spinal metastases underwent palliative surgery by posterior decompression of spinal cord and subsequent stabilization with instrumentation. There were 38 women and 32 men. Their ages ranged from 24 to 75 years (mean 58 years). We retrospectively reviewed medical records to analyze their survival, clinical presentations, image findings and surgical outcomes.

Results: Sixty-one patients (87%) survived longer than 3 months. Forty-nine patients (70%) survived longer than 6 months, of whom 35 patients were still alive at an average of 24 months (range 13-40 months) after surgery. All maintained spinal stability postoperatively. Forty-seven of 60 patients (78.3%) with severe pain obtained significant symptomatic relief for 3 months or more, and 38 of 54 (70.1%) paralyzed patients gained neural improvement. Of the 60 patients bedridden before surgery due to pain or paresis, 36 patients (60%) experienced an increase in activity tolerance.

Conclusions: The results of this study shows that neurological recovery, pain relief and mobility can be enhanced by posterior decompression and stabilization in highly selective patients with spinal metastases.

(Chang Gung Med J 2004;27:903-10)

Key words: **metastatic spine disease, posterior decompression, stabilization.**

The spine is a common site for tumor metastasis. Spinal metastasis usually signifies the patient's terminal stage.[1-3] Due to spinal destruction and spinal cord compression, the patients often present with pain and paralysis. Although traditional therapies including radiation, chemotherapy and hormonal therapy can relieve pain and reduce tumor size to a certain degree, they are unable to restore spinal stability.[4,5]

The two types of surgical method used for spinal metastases are anterior decompression and posterior approach. The former permits direct tumor removal, decompression and reconstruction of the body for corporal metastasis.[5-10] However, the technique of anterior corpectomy is restricted to anteriorly located tumors, single or adjacent vertebral lesions in our department. Palliative surgery by posterior decompression with segmental instrumentation is

From the Department of Orthopaedic Surgery, Chang Gung Memorial Hospital, Taipei; Chang Gung University, Taoyuan.
Received: Aug. 18, 2004; Accepted: Nov. 29, 2004
Address for reprints: Dr. Lih-Huei Chen, Department of Orthopaedic Surgery, Chang Gung Memorial Hospital. 5, Fushing Street, Gueishan Shiang, Taoyuan, Taiwan 333, R.O.C. Tel.: 886-3-328-1200 ext. 2163; Fax:886-3-327-8113; E-mail: lhchen2132@adm.cgmh.org.tw

accepted as a reasonable procedure in patients with extensive metastatic disease.[2,5,7,8,13] Posterior procedure is suggested as an alternative if the tumor compression was predominantly posterior, if there were multiple levels involved, or if the tumor level precluded access anteriorly.[2,5,7,11-14]

The purpose of the present study was to assess survival, pain, neurological function and complications after posterior decompression of the spinal cord and subsequent stabilization in patients suffering from thoracolumbar metastases.

From 1980 to 2001, 82 patients underwent posterior decompression for epidural compression and subsequent stabilization by instrumentation for multiple metastatic spine disease. Twelve patients were lost to follow-up, leaving 70 patients in this group study. There were 38 women and 32 men. Their ages ranged from 24 to 75 years (mean 58 years).

Extensive pre-operative screening was carried out including plain radiographs, bone scan, computed tomography (CT) scans or magnetic resonance imaging (MRI). The number of affected vertebrae amounted to 268. Ninety-six tumorous lesions were identified in the lumbar spine and 172 in the thoracic spine. The primary malignancies were breast cancer in 13 patients, hepatoma in 10, thyroid cancer in 8, lung cancer in 7, renal cancer in 6, melanoma in 5, cervical cancer in 3, and cancers of the stomach, nasopharynx in 2 patients each. A primary carcinoma was never identified in 14 patients (Table 1).

Neurological status was graded according to the Frankel scale.[15] Pre-operatively, 6 patients had a grade A neurological status, 20 grade B, 16 grade C, 12 grade D, and 16 grade E. The stability of the spine was evaluated radiographically in accordance with the concept of the three-column spine.[16,17] The diagnosis of spinal instability was made when there was osseous destruction of more than 50% of the width of the vertebral body, bone loss extending over more than a single spinal segment, or presence of additional destruction of the posterior elements at the same level.[11,18]

Table 1. Primary Cancer and Pathology

Origin	No.	Pathology
Breast	13	Adeno CA (13)
Liver	10	Hepatocellular (10)
Thyroid	8	Adeno CA (2), follicular CA (6)
Lung	7	Squamous cell CA (2), adeno CA (3), anaplasic CA (2)
Renal	6	Transitional cell CA(1), renal cell CA (5)
Skin	5	Melanoma (5)
Cervical	3	Squamous cell CA (3)
Stomach	2	Adeno CA (2)
Nasopharynx	2	Anaplasic CA (2)
Unknown	14	Squamous cell CA (4), adeno CA (10)

Abbreviations: CA: carcinoma.

Operative intervention was denied for patients with a life expectancy estimated to be less than 3 months. Widespread visceral metastases, large metastatic lesions in all three spinal region (cervical, thoracic and lumbar), severe nutritional depression and immunosuppression are all relative contraindications for surgical reconstruction. Indications for posterior spinal reconstructive surgery for patients were severe pain unresponsive to strong narcotic analgesic in 60 patients, neurological deficits in 54 and unstable spine in 48. Fifty patients received chemotherapy or radiotherapy prior to consultation with the spine surgeon and had not improved or deteriorated. The patients were already paraparetic or paraplegic, leading to a bedridden and very painful leg or backache, and therefore we hoped that surgical decompression and fixation could provide pain relief, maintain spinal stability and restore neurological function.

METHODS

Operative methods included wide decompression through a dorsal approach, mostly laminectomy and resection of the destructed facet joints, including the removal of osseous or tumorous mass. Debridement and debulking the tumor and decompression of the spinal cord or cauda equine was carried out in each case with the goal of disrupting normal bone minimally. Afterwards posterior stabilization with instrumentation was done without bone grafting. The instrumentation technique consisted of bilateral segmental instrumentation. A minimum of four-point fixation was achieved bilaterally. The range of fixation depended on the number of affected vertebrae, usually ending 2 vertebral cephad and caudal to the metastatic lesion. Short fixation in the lumbar and thoracolumbar was sometimes performed with pedicle screws; for longer ranges hook fixation was preferred particularly in upper thoracic levels. Four of 6 patients with spinal metastases from renal

tumor had pre-operative embolization. The median duration of the operation was three hours (range, two to five hours), and the medium blood loss was 2100 ml (range, 900 to 8200 ml). Operation time and blood loss depended on the numbers of segments stabilized. Methylmethacrylate was used in conjunction with metallic implants as an adjunct for fixation and immediate stability (Figs. 1-2).

Adequate nutrition should be supplemented by both enternal and parental alimentation during the entire course of treatment. Radiotherapy and chemotherapy were always performed by the radiotherapist and oncologist. Radiation delivered either pre or post operatively ranged from 2000 to 4000 Cgy. Patients were allowed ambulation with light brace protection after surgery.

Evaluations included hospital charts, initial and interval roentgenograms, as well as personal interview and examination of surviving patients. Follow-up examinations were performed every two months after surgery.

RESULTS

Survival Of the 70 patients, 4 died within 1 month, one each due to hepatic failure and sepsis, and two respiratory failure. Five patients died within 3 months. Sixty-one patients (87%) survived longer than 3 months. Forty-nine patients (70%)survived longer than 6 months, of whom 26 patients were still alive at an average 24 months (range 13-40 months) after surgery (Table 2). Survival was closely related to the primary lesions, being 38 months for melanoma, 29 months for thyroid cancer, 18 months for breast cancer, 16 months for renal tumors, and 8 months for lung cancer.

Pain Relief Pain relief was considered good if the patients was able to sit or stand for 1 hour or longer and could be managed on oral pain medicine. Such pain relief had to be achieved at least 3 months after hospital discharge to be considered to have significantly helped the patients. Of sixty patients with severe pain, forty-seven (78.3%) obtained pain relief for 3 months or more.

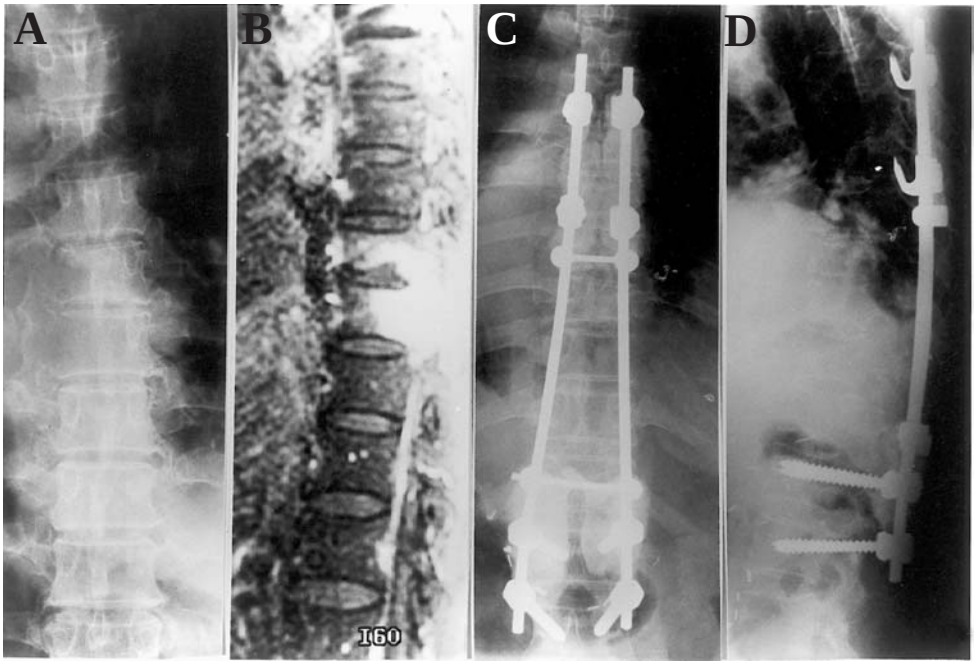

Fig. 1 62 years old female presented with breast cancer. (A) Pre-operative anteroposterior radiograph showing pedicle destruction at T7 and T8; (B) Sagittal magnetic resonance scan showing pathological fractures of the T7 and T8 and an abnormal marrow signal extending into the posterior element; (C-D) Postoperative radiographs showing stabilization with Moss-Miami hook and pedicle screws with bone cement.

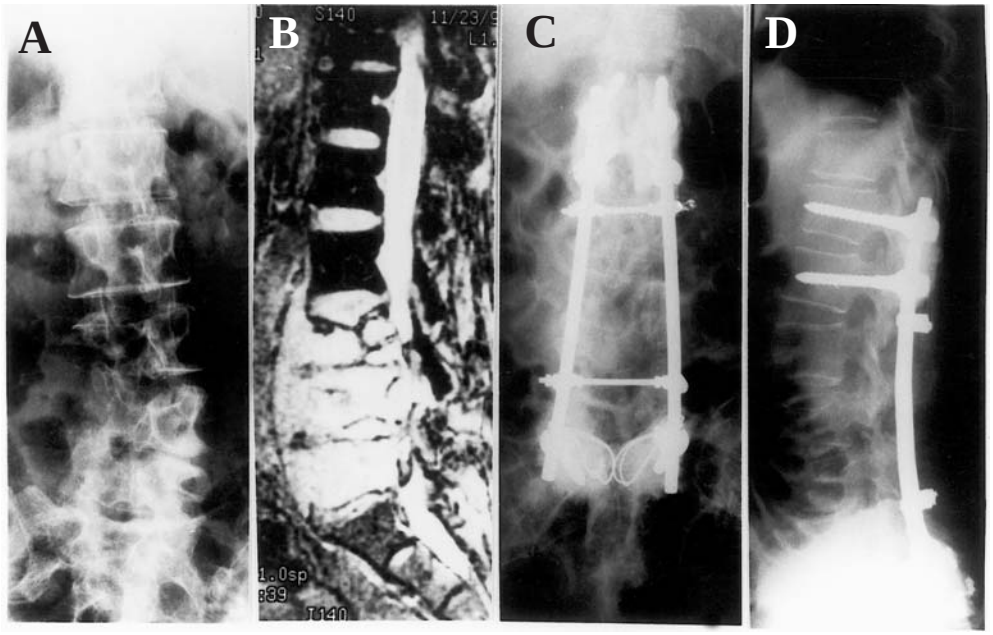

Fig. 2 70 years old male presented with colon cancer. (A-B) Pre-operative anteroposterior radiograph and sagittal magnetic resonance scan of lumbar spine showing destruction of L3,4,5 body with retropulsion of body detritus into the spinal canal; (C-D) Postoperative radiographs showing stabilization with pedicle screws and bone cement in the posterior.

Table 2. Postoperative Survival

Months	No. of patients
0- 1	4
1- 3	5
3- 6	12
6-12	14
13-18	20
18-24	9
>24	6

Neurological Function Fifty-four patients presented with neurological deficits. Neurological improvement of at least one Frankel grade was noted in 38 patients (Table 3). No improvement was noted in patients with a Frankel A neurological deficit at presentation. Of sixty bedridden patients before surgery due to pain or paresis, 36 increased activity tolerance. Twenty patients were able to recover functional ambulation and sphincter dysfunction was significantly improved in 10 patients.

Complications The majority of patients were seriously debilitated by malignancy or treatment modalities for their metastatic diseases. Thus, several

Table 3. Neurological Status in Frankel Grading: Preoperatively and at Last Follow-up

		Postoperative Neurological Status					Total
		A	B	C	D	E	
Preoperative	A	6					6
Neurological	B		3	14	3		20
Status	C			4	11	1	16
	D				3	9	12
	E					16	16
Total		6	3	18	17	26	70

complications arose in the immediate postoperative period of hospitalization. There were 3 pulmonary infections in patients who previously underwent polychemtherapy. Additionallly, one stress ulcer bleeding was recognized in the first postoperative week and require endoscopic intervention. Six patients required re-operation by posterior surgery for tumor recurrence at the same or at a new level. Without undergoing pre-operative embolization, one patient with renal cell carcinoma died due to uncontrollable bleeding during surgery. Wound infection with dehiscence was noted in 5 patients and was successfully managed by wound debridement and care.

DISCUSSION

Back pain and neurological deficits are the main clinical symptoms in spinal metastasis and would be secondary to neural compression or pathologic spinal instability. Treatment of patients with metastatic disease of the spine is controversial. Conservative treatment is weighed against surgical options, using many factors and with well-defined goals. Pain relief and maintaining quality of life must be balanced with life expectancy, comorbilities and functional status.[3-5,7,19-21] Surgical goals include decompression of neural structures, debulking tumor mass, realignment of spinal deformity, stabilization allowing mobilization, and pain relief. If surgery is attempted, complications should be minimized to enhance it as a treatment option.[22]

In most of patients, an anterior approach would have permitted more direct access to the tumor, making expiration of tumor tissue easier as well as decompression of compromised neurological structure.[5-10] A posterior approach was used in these cases instead of an anterior one for the following reasons. Patients with a posteriorly located tumor leading to epidural compression, three column involvement, more than two adjacent vertebrae, translocation, multiple metastases and poor general status are not ideal candidates for an anterior procedures.[5,7,10-14,23] The indications for considering surgical treatments included intractable pain unresponsive to conservative treatment in 60 cases, progressive neurological deficits in 54 and pathological fracture or potential instability of involved spine in 48.

The patients certainly benefited from posterior decompression and stabilization for metastatic spine disease: 47 patients (78.3%) obtained significant pain relief and 38 (70.1 %) of those neurological deficits improved after surgery. Of the 60 patients who were bedridden before surgery, 36 patients (60%) increased functional activity, and 20 patients became ambulatory and were satisfied with the result afterwards.

The relatively low risk with posterior surgery has also been reported in smaller series.[12,13,17] However, posterior decompression and stabilization should not be considered a minor procedure. The operative time in this study averaged 182 minutes, blood loss 2100 ml. Pre-operative embolization is recommended in particular for metastases deriving from kidney cancer in order to reduce blood loss.[22] One perioperative death occurred due to uncontrolled bleeding, from repeat surgery for recurrent tumor with renal cell carcinoma. There were five wound infections with dehiscence, two after radiation therapy. If possible, preoperative radiation therapy for patients who have spinal instability or collapse, spinal cord compression caused by bone fragments, or rapid progressive neurological deficits should be avoided. Exceptions may include highly radiosensitive tumors like germ cell or lymphoproliferative tumors.[24]

Stability for posterior reconstuction in the series was established with methylmethacrylate bone cement with screws or hooks and rods. Cement is highly effective in resisting the compression forces but quite weak against shear force.[25] Bone cement does not influence postoperative radiotherapy.[25,26] If the patient has a rather healthy condition with a long-term life expectancy, bone graft for osseous fusion can be considered instead of bone cement. However, we were not able to use this procedure in our cases. All maintained spinal stability without implant displacement at the last follow-up.

Regarding the survival time, 87% lived for more than 3 months, 70% lived over 6 months, and 36% over 1 year. In general, when selecting the patients, our prognostic factors included the nature of the tumor, single or multiple involvement, general condition of the patient and status of neurological function. The average survival time for the 10 patients with hepatoma, 7 with lung cancer, 13 with breast cancer, 8 with thyroid cancer, and 5 melanoma documented in this study was 7, 8,18, 29 and 38 months, respectively. The 10 patients with lung cancer and 21

with breast cancer reported by the Rush medical center in Chicago survived 6 and 9 months, respectively.[5,7] Patients with cancer of the breast or kidney or with myeloma have a far better chance of long survival than those with prostate and lung cancer.[15] Therefore, we predict that the prognosis is closely linked to the characteristic of the primary tumor and its metastasis. Multiple metastases are defined as multiple levels of spinal metastasis or multiple organ involvement, and correlate with the malignancy of tumor or the time of discovery. The general condition of the patients, such as poor nutritional status, or having cardiac, pulmonary, hepatic, or renal function impairments, could increase the risks of surgery and jeopardize the prognosis. A Frankel grade A neurological deficit indicates that the area of tumor invasion is extensive, and that there is a long course of disease and a poor prognosis.[7,10] Hammerberg pointed out that a patient who cannot survive the physiologic vigors of major surgery is not a candidate.[7] In general, a minimal life expectancy of 3 to 6 months has been accepted as a prerequisite for surgery.[7,20,21] Reasonable indications could be summarized as follows: the patient should not have a life expectancy of less than 3 months and both the immunity and nutritional status should be adequate enough for wound healing. Therefore, preoperative evaluation and post-operative care, as well as nutritional supplements are indispensable elements. Surgical plans must be formulated taking into account life expectancy, health and nutritional status the primary tumor tissue type, neurological status, spinal stability and destruction, degree of pain and the wishes of patient and family.

In conclusion, neurological recovery and pain relief can be achieved by posterior decompression and stabilization in highly selective patients with spinal metastases.

REFERENCES

1. Fornasier VL, Horne JG. Metastasis to the vertebral column. Cancer 1975;36:590-4.
2. Guri JO. Tumors of the vertebral column. Surg Gynecol Obster 1984;87:583-98.
3. Harrington KD. Metastatic disease of the spine. J Bone Joint Surg 1986;68A:1110-5.
4. Cobb CA, Learens ME, Eccles N. Indications for nonoperative treatment of spinal cord compression due to breast cancer. J Neurosurg 1977;47:653-7.
5. DeWald RL, Bridewell KH, Prodromas C, Rodts MF. Reconstructive spinal surgery as a palliation for metastatic malignancies of the spine. Spine 1985;10:21-6.
6. Fidler MW. Anterior decompression and stabilization of metastatic spinal fracture. J Bone Joint Surg 1986;68B:83-90.
7. Hammerberg KW. Surgical treatment of metastatic spine disease. Spine 1992:17:1148-53.
8. Harrington KD. The use of methylmethacrylate for vertebral body replaccment and anterior stabilization of pathologic fracture dislocation of the spine due to metastatic malignant disease. J Bone Joint Surg 1981;63A:36-46.
9. Harrington KD. Anterior decompression and stabilization of the spine as a treatment for vertebra collapse and spinal cord compression from metastatic malignancy. Clin Orthop 1988;233:177-97.
10. Chen LH, Chen WJ, Niu CC, Shih CH. Anterior reconstructive spinal surgery with Zielke instrumentation for metastatic malignancies of the spine. Arch Orthop Trauma Surg 2000;120:27-31.
11. Siegal T, Tiqva P, Siegal T. Vertebral body resection for epidural compression by malignant tumors. J Bone Joint Surg 1985;67A:375-82.
12. Bauer CF. Posterior decompression and stabilization for spinal metastases. J Bone Joint Surg 1997;79A:514-22.
13. Rompe JD, Hopf CG, Eysel P. Outcome after palliative posterior surgery for metastatic disease of the spine-evaluation of 106 consecutive patients after decompression and stabilization with the Cotrel-Dubousset instrumentation. Arch Orthop Trauma Surg 1999;119:394-400.
14. Bridwell KH, Jenny AB, Saul T, Rich KM, Grubb RL. Posterior segmental spinal instrumentation (PSSI) with posterolateral decompression and debulking for metastatic thoracic and lumbar spine disease. Spine 1988;12:1383-94.
15. Frankel HL, Hancock DV, Hyslop G. The value of postural reduction in initial management of closed injuries of the spine with paraplegia and tetraplegia. Paraplegia 1969;7:179-92.
16. Denis F. The three column spine and its significance in the classification of acute thoracolumbar injuries. Spine 1983;8:817-31.
17. Denis F. Spinal instability as defined by the three column concept in acute spinal trauma. Clin Orthop 1984;189:65-76.
18. Kostuik JP, Errico TJ, Gleason TF, Errico CC. Spinal stabilization of vertebral column tumors. Spine 1988;13:250-6.
19. Sundaresan N, Digiacinto GB, Hughes JEO. Surgical treatment of spinal metastases. Clin Neurosurg 1986;33:503-22.
20. O'Neil J, Gardner V, Armstrong G. Treatment of tumours of the thoracic and lumbar spinal column. Clin Orthop 1988;227:103-12.
21. Hosono N, Yonenobu K, Fuji T, Ebara S, Yamashita K, Ono K. Orthopaedic management of spinal metastases.

Clin Orthop 1995;312:148-59.
22. Wise JJ, Fischgrund JS, Herkowitz HN, Montgomery David, Kurz LT. Complication, survival rates, and risk factors of surgery for metastatic disease of the spine. Spine 1999;24:18:1943-51.
23. King GJ, Kostuik JP, McBroom RJ, Richardson W. Surgical management of metastatic renal carcinoma of the spine. Spine 1991;16:265-71.
24. Janjan NA. Radiotherapeutic management of spinal metastases. J Pain Symptom Manage 1996;2:223-31.
25. Eftekhar NS, Thurston CW. Effect of irradiation on acrylic cement with special reference to fixation of pathological fractures. J Biomech 1975;8:53-6.
26. Walker PS. Human joints and their artificial replacement. Charles C. Thomas, Springfield, 1977;424.

轉移性脊椎病變：由後位減壓術和內固定術的外科療法

陳力輝 牛自健 傅再生 賴伯亮 黃澤波 陳文哲

背 景： 本回溯性研究的目的在於探討，以後位減壓術及內固定術來治療胸腰椎癌轉移病變的臨床結果。

方 法： 由1980至2001年間，共有70位脊椎轉移病變的病人接受以後位作脊索減壓術及金屬內固定的外科手術，男性38位，女性32位，年齡分布由24歲至75歲 (平均58歲)，根據病歷資料分析其存活時間、臨床表現、影像學發現及手術預後。

結 果： 61位病人 (87%) 存活超過3個月，49位病人(70%) 存活超過6個月，35位病人在術後平均24個月 (範圍13至40個月) 時，仍存活著。所有病人術後都有維持著良好的脊椎穩定度，60位有嚴重疼痛病人中，47位 (78.3%)得到明顯疼痛症狀減輕，達3個月或更久的時間。在54位有神經缺失病人中，38位 (70.1%) 獲得神經功能的改善，60位術前因疼痛或半癱而臥床的病人中，36位 (60%) 得到活動力增加。

結 論： 這研究的臨床結果顯示，特定選擇的病人發生胸腰椎轉移性病變，經由後位手術予以減壓術及內固定外科療法，具有神經功能恢復，疼痛減輕及活動能力增加之療效。

(長庚醫誌 2004;27:903-10)

關鍵字：轉移性脊椎病變，後位手術，固定術。

長庚紀念醫院 台北院區 骨科
受文日期：民國93年8月18日；接受刊載：民國93年11月29日。
索取抽印本處：陳力輝醫師，長庚紀念醫院 骨科。桃園縣龜山鄉復興街5號。Tel: (03)3281200轉2163; Fax: (03)3278113; E-mail: lhchen2132@adm.cgmh.org.tw