Spinal Cord (2007) 45, 671–677

www.nature.com/sc

Original Article

Prognostic indicators in metastatic spinal cord compression: using functional independence measure and Tokuhashi scale to optimize rehabilitation planning

V Tang*[,1,2], D Harvey[2,3], J Park Dorsay[4], S Jiang[2,5] and MP Rathbone[1,2]

[1]*Department of Medicine, Division of Neurology, McMaster University Hamilton, Canada;* [2]*Hamilton NeuroRestorative Group, Hamilton, Canada;* [3]*Department of Medicine, Division of Physical Medicine and Rehabilitation, McMaster University Hamilton, Canada;* [4]*Rehabilitation and Orthopedic Program, Hamilton Health Sciences, Henderson General Hospital, Hamilton, Canada;* [5]*Department of Surgery, Division of Neurosurgery, McMaster University, Hamilton, Canada*

Study design: Retrospective, descriptive study.
Objective: To determine if patients with metastatic spinal cord compression (MSCC) make significant functional gains through rehabilitation. To study survival and predictors of survival in MSCC. To explore predictive factors for high or low functional gains in MSCC.
Setting: Inpatient neuro-oncology rehabilitation ward, Henderson General Hospital, Hamilton, Canada.
Methods: Clinical records were examined for 63 inpatients with MSCC. Demographics, treatment of MSCC, length of rehabilitation, admission, and discharge Functional Independence Measure (FIM) scores, Tokuhashi score and survival data were collected. Statistical analyses included nonparametric comparisons, Kaplan–Meier analyses, Cox regression, and exploratory logistic regression.
Results: FIM score improved from 83 to 102 ($P<0.0001$). Estimated median survival from time of rehabilitation was 10.0 months. Kaplan–Meier analysis showed longer survival in patients with high Tokuhashi scores (9–15) compared to low scores (0–8) ($P<0.005$); and high FIM change (>13) compared to low FIM change ($\leqslant 13$) ($P<0.02$). Cox regression revealed that high FIM gain and high Tokuhashi score were prognostic factors. Logistic regression showed Tokuhashi score (odds ratio (OR) = 1.30, 95% confidence interval (CI) = 1.04–1.62) and length of rehabilitation (OR = 1.04, 95% confidence interval (CI) = 1.01–1.07) were associated with high FIM gain.
Conclusions: Rehabilitation improves functional outcomes in MSCC. Patients who had a high Tokuhashi score and achieved high functional gains after rehabilitation had longer survival. Tokuhashi score and length of rehabilitation were associated with high FIM gain. The Tokuhashi score can help identify patients with good prognosis and potential for improvement during rehabilitation.
Spinal Cord (2007) **45,** 671–677; doi:10.1038/sj.sc.3102024; published online 16 January 2007

Keywords: spinal cord compression; spinal metastasis; rehabilitation; functional independence measure; prognosis

Introduction

Metastatic spinal cord compression (MSCC) is a disabling complication of cancer and has a significant impact on quality of life in cancer patients. Metastases to the spinal column occur in 5–10% of cancer patients, and occur in all types of cancer including breast, prostate, lung, and hematologic cancers.[1] They often present with back pain, progressive weakness, decreased sensation, as well as bladder and bowel incontinence, in addition to the systemic effects of cancer. Presently, the treatment options for MSCC are surgery, radiation therapy, chemotherapy, and palliative care. A groundbreaking study by Patchell *et al*[2] showed that patients treated with surgery and radiotherapy had significantly better outcomes than radiotherapy alone, in terms of

*Correspondence: V Tang, Neurology Henderson General Hospital, 70 Wing, Ground Floor, Room 23, 711 Concession Street, Hamilton, Ontario, Canada L8V1C3

walking ability, incontinence, survival and use of morphine equivalent.

After surgery and, in many cases, concurrently with the primary treatment of the cancer and cord compression, rehabilitation treatment is an integral component in the management of patients with metastatic spinal cord injury. The goals of cancer rehabilitation include prevention of deficits, restoration of function, minimization of handicap and palliation. Through rehabilitation, the patient gains functional independence in transfers, bladder and bowel management, ambulatory ability through the necessary equipment aids and improvement in overall strength to become ready for discharge home or long-term care residence. The Functional Independence Measure (FIM) is a valid and reliable rehabilitation evaluation measure of 18 items in six categories of self-care.[3,4] Data are from the rehabilitation provider perspective, based on observation and discussion with the patient. It is the predominant outcome measure in the rehabilitation setting, measures the success of a rehabilitation program and correlates with the amount of care-giver time. A study by McKinley *et al*[5] found that patients with MSCC achieve rates of functional gains, as measured by the FIM scores, similar to those with traumatic spinal cord injury.

Given the limited survival in MSCC, there is a need for optimization of rehabilitation management to strike a balance between a longer course of rehabilitation for better functional outcomes, *versus* an expedited course to allow more time for the patients to be with loved ones at home. A reliable tool to predict life expectancy is important for planning rehabilitation efficiently. The revised Tokuhashi scale is a reliable scoring system for evaluating prognosis in spinal metastases, with over 80% reliability.[6] Parsch *et al*[7] examined 68 patients and found that the admission FIM score, female gender, lower age at time of spinal cord injury, and incomplete neurological deficit (Frankel B, C, and D) were positive prognostic factors. Eriks *et al*[8] found that muscle strength grade 4–5, transfer ability, American Spinal Injury Association (ASIA) D classification, dressing ability, remission of tumor, toileting, bathing, walking ability and bladder continence were significant clinical indicators; of note, many of those factors are evaluated in the FIM assessment.

For this study, the main objectives were: (1) to examine whether patients with MSCC can make significant functional gains through rehabilitation; (2) to assess survival and determine predictors of survival in MSCC, including FIM and Tokuhashi scores; and (3) to explore predictive factors for high or low functional gains in MSCC. No previous studies have looked at changes in FIM score and survival. This study is important because with greater knowledge about prognosis, we can plan a rehabilitation program tailored to the needs of the patient.

Methods

This was a retrospective, descriptive study using review of clinical records. Ethics approval was obtained from the Research Ethics Board of Hamilton Health Sciences to conduct this study.

Patients

Clinical records from computerized databases, paper charts and charts on microfiche from all patients with MSCC admitted to the Inpatient neuro-oncology rehabilitation ward at the Henderson General Hospital in Hamilton, Canada, between 2001 and 2005 were reviewed. A total of 69 consecutive inpatients were identified to have MSCC. FIM scores were incomplete or unavailable for 6 patients, and they were excluded from data analyses. Data were analyzed for 63 patients. Three patients died on the rehabilitation ward and were given the lowest discharge FIM score of 18.

FIM scores

The FIM score[3,4] includes six areas of self-care (eating, grooming, bathing, dressing of upper body, dressing of lower body and toileting), two of sphincter control (bladder and bowel), three of transfer ability (in a bed, chair, and/or wheelchair; on and off a toilet; and in and out of a tub and/or shower), two of locomotion (walk/wheelchair and stairs), two of communication (comprehension and expression), and three of social cognition (social interaction, problem solving and memory). The 18 categories are each scored from 1 to 7 for a total of 126. A score of 1 or 2 indicates complete dependence, as the person contributes less than half the energy and requires maximal or complete assistance. A score of 3, 4, or 5 indicates modified dependence, with the person exerting more than half the energy but still needing some assistance. A score of 6 or 7 indicates independence, either with or without use of an assistive device to perform the task, and no helper is needed.

Data collection

Data were acquired for age, gender, and length of rehabilitation. Cancer data included type of primary tumor and treatment for MSCC. Spinal cord compression data included neurological level and ASIA score. We obtained admission and discharge FIM scores. For the revised Tokuhashi scale, information was obtained for the general medical condition, number of extraspinal bone metastases, number of metastases in the vertebral body, metastases to major internal organs, primary site of cancer and spinal cord palsy.[6] We reviewed consultation notes, progress notes, operative reports, MRI or CT scans of the spine for vertebral metastases, whole body bone scans and X-rays for extraspinal metastases, and abdominal and chest imaging for organ metastases. Survival data were collected by searching the local obituaries and contacting family physicians and oncologists. Survivorship was calculated as survival in months after rehabilitation.

Data analysis

Data collection was completed in August 2006. Data were analyzed using SPSS Version 14.0 for Windows

(Chicago, ILL, USA). Descriptive statistics were used for the demographic and clinical data. Continuous variables were described as means (standard deviation, (SD)) for parametric data and medians (inter quartile range (IQR)) for nonparametric data. Mann–Whitney *U*-test and Wilcoxon matched pairs signed-rank test were used for comparisons of nonparametric data. The FIM efficiency was calculated as FIM change divided by length of rehabilitation in days.

Kaplan–Meier survival analyses were used to estimate survivorship. The parameters were defined by the median or categorically for: Tokuhashi score, admission FIM score, FIM change, length of rehabilitation, age, gender, ASIA score, neurological level, and treatment of MSCC (surgery *versus* no surgery). The log-rank test was used to detect significant differences between the groups.

Multivariate analysis using Cox regression was performed to determine prognostic factors with the same parameters as those used in the Kaplan–Meier analyses. Forward selection was used to select all statistically significant variables to include in the equation. Backward selection was used to exclude variables that were not significant and to confirm the results from forward selection.

Exploratory logistic regression was used to identify factors associated with low or high FIM change ($\leqslant 13$ *versus* >13). The independent variables were Tokuhashi score, admission FIM score, length of rehabilitation, age, gender, neurological level, ASIA score and surgical treatment of MSCC. Backward stepwise selection was used to exclude nonsignificant variables and identify relationships in this exploratory model. $P<0.05$ were considered statistically significant.

Results

Demographics

The mean age on admission to the rehabilitation ward was 62.5 years (SD 12.2). The median length of stay on the rehabilitation ward was 23 days (IQR 17–42) and the median Tokuhashi score was 8 (IQR 5–9). There were 33 female subjects and 30 male subjects (Table 1). The majority of patients had a lesion at the thoracic level (69.8%), followed by the lumbosacral (20.6%) and cervical levels (9.5%) (Table 1). For ASIA scores, the majority had ASIA D (74.6%), followed by ASIA C (12.7%), ASIA A (6.3%), ASIA E (4.8%), and ASIA B (1.6%) (Table 1). Table 1 further describes the number of extraspinal bony metastases, number of vertebral metastases and major organ metastases. The primary tumors were predominantly breast carcinoma or hematologic cancers. Others were lung, prostate, colon, renal, gastric, endometrial, thyroid, and gastrointestinal stroma (GIST) carcinoma; two patients had unknown primary tumors (Table 2). Patients underwent surgery, chemotherapy, radiation therapy, or palliative care for treatment of MSCC (Table 3).

For the three patients who died on the rehabilitation ward, the mean age was 75.7 years, length of stay ranged from 4 to 59 days, admission FIM score ranged from 63 to 97, all had three or more vertebral metastases, all had unresectable major organ metastases, and all had a Tokuhashi score of 5 or less. Mann–Whitney *U*-test showed the group that died on the rehabilitation ward had a significantly lower Tokuhashi score ($P=0.046$). They were older ($P=0.037$) than those who were alive on discharge.

Table 1 Baseline characteristics

	n	%
Gender		
Male	30	47.6
Female	33	52.4
Level of lesion		
Cervical	6	9.5
Thoracic	44	69.8
Lumbosacral	13	20.6
ASIA score		
ASIA A	4	6.3
ASIA B	1	1.6
ASIA C	8	12.7
ASIA D	47	74.6
ASIA E	3	4.8
No. extraspinal metastases		
None	21	33.3
1–2	13	20.6
3 or more	29	46.0
No. vertebral metastases		
1	14	22.2
2	14	22.2
3 or more	35	55.6
Major organ metastases		
None	41	65.1
Resectable	3	4.7
Unresectable	19	30.2

Table 2 Primary tumor histologies

	n
Breast	17
Multiple myeloma	10
Lymphoma	8
Lung	8
Prostate	4
Colon	5
Renal cell	2
Gastric	2
Chordoma	2
Unknown	2
Endometrial	1
Thyroid	1
GIST	1

Table 3 Treatment of MSCC

	n
Surgery, chemotherapy, and radiation therapy	14
Surgery and radiation therapy	11
Surgery and chemotherapy	8
Chemotherapy and radiation therapy	13
Surgery only	7
Radiation therapy only	6
Chemotherapy only	2
Palliative care only	2

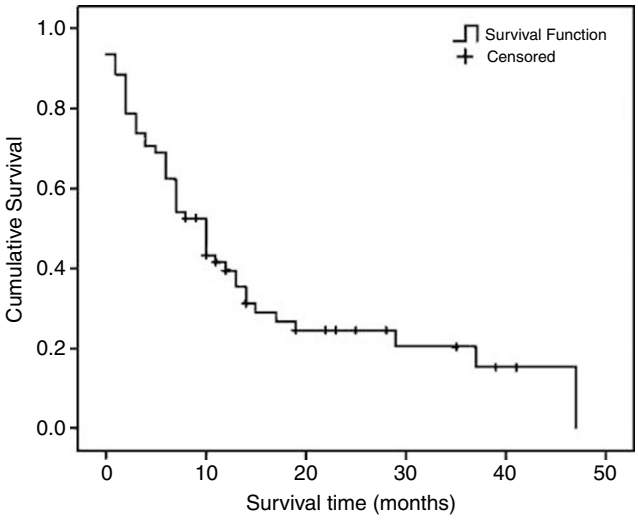

Figure 1 Kaplan–Meier survival curve for all MSCC patients

Functional independence measure scores
There was a significant improvement in FIM score ($P = 0.00004$) from median admission FIM of 83 (IQR 72–96) to discharge FIM of 102 (IQR 80–110). The FIM efficiency (FIM change/length of rehabilitation in days) was 0.38 (IQR 0.05–0.76).

Survivorship
Of the 63 patients, 46 patients had a known date of death, 15 patients were alive at the time of data analyses and two were lost to follow-up. Estimated median survival after rehabilitation was 10.0 months (IQR 3.0–19.0) by the Kaplan–Meier method (Figure 1). The 3-, 6-, 12-, and 24-month actuarial survivals were 74, 62, 39, and 24%, respectively (Table 4).

Univariate analyses of prognostic factors for survival
The Kaplan–Meier survival analysis by log-rank test showed a significant difference in survival between patients with a high Tokuhashi score (9–15) compared to a low score (0–8) ($P = 0.003$) (Figure 2). There was a significant difference in survival between patients with a low FIM change ($\leqslant 13$) compared to a high FIM change (> 13) ($P = 0.012$) (Figure 3).

Kaplan–Meier analysis did not show significant differences in survival for the parameters of admission FIM ($P = 0.912$), length of rehabilitation ($P = 0.995$), ASIA score ($P = 0.333$), level of lesion ($P = 0.533$), gender ($P = 0.192$), surgical treatment of MSCC ($P = 0.988$), or age ($P = 0.175$). The median survival for each of the parameters and the actuarial survivals at 3-, 6-, 12-, and 24-months are shown in Table 4.

Multivariate analysis of prognostic factors for survival
Cox regression using forward selection showed that high FIM change and high Tokuhashi score were positive prognostic factors. Backward selection verified this finding. The results from the Cox regression analysis are summarized in Table 5.

Predictors of functional gain
Exploratory logistic regression using a backward stepwise method showed Tokuhashi score (odds ratio (OR) = 1.30, 95% confidence interval (CI) = 1.04–1.62, $P = 0.022$) and length of rehabilitation (OR = 1.04, 95% CI = 1.01–1.07, $P = 0.021$) were significantly associated with high FIM gain.

Discussion

Rehabilitation is valuable for improving functional independence in neuro-oncological patients with spinal cord compression. The rehabilitation ward at the Henderson General Hospital is situated in close proximity with the Hamilton Regional Cancer Centre, at the Juravinski Cancer Centre. Many of the neuro-oncology patients receive concurrent treatment for their primary cancer and multi-disciplinary rehabilitation treatment.

Among those unfamiliar with the role of rehabilitation in cancer treatment, there may be a perception that rehabilitation unnecessarily prolongs the stay in hospital and is only reserved for patients with very good prognosis. Data from our study indicate that participation in a rehabilitation program significantly improves functional outcomes in patients with MSCC, as shown by the improvement from baseline to discharge FIM. Indeed, these improvements range across aspects of self-care that would have an impact even after discharge from hospital: the ability to mobilize, transfers, bladder and bowel management, and cognition. The FIM efficiency from our study was 0.38 per day. This value is comparable to those reported in previous studies with metastatic spinal cord injury of 0.33 per day[7] and 0.42 per day.[9] The FIM efficiency was lower in patients with metastatic cancer than in patients with traumatic spinal cord injury, which has been reported as 0.75 per day[10] and 1.3 per day.[11] This is not unexpected given the different age, comorbidities, and systemic effects of cancer.

Our study confirms the usefulness of the Tokuhashi scale as a prognostic tool.[6,12–14] Another prognostic

Table 4 Median survival (months) and actuarial survivals (%) for Kaplan–Meier analyses

	Actuarial survivals (%)					
Parameter	*3 months*	*6 months*	*12 months*	*24 months*	*Median (months)*	P-*value*[a]
All cases	74	62	39	24	10.0	
Tokuhashi score						0.003
0–8	62	45	22	14	6.0	
9–15	95	95	71	44	15.0	
Admission FIM						0.912
$\leqslant 83$	72	62	43	29	10.0	
>83	76	62	34	30	10.0	
FIM change						0.012
$\leqslant 13$	58	48	20	15	6.0	
>13	90	77	59	34	14.0	
Length of rehabilitation						0.995
$\leqslant 23$ days	73	67	38	25	10.0	
>23 days	74	58	41	24	10.0	
Age						0.175
$\leqslant 64$	90	74	40	31	10.0	
>64	57	50	39	17	6.0	
Gender						0.192
Female	81	71	48	31	12.0	
Male	67	53	30	17	7.0	
ASIA						0.333
A	100	25	0	0	6.0	
B	100	100	0	0	10.0	
C	50	50	25	0	2.0	
D	76	67	46	28	11.0	
E	67	67	67	67	29.0	
Level of lesion						0.533
Cervical	50	50	0	0	2.0	
Thoracic	77	73	43	28	10.0	
Lumbosacral	85	62	36	18	10.0	
Treatment of MSCC						0.988
Surgery	75	65	38	27	10.0	
No surgery	71	57	42	21	7.0	

[a]Log-rank test

factor for survival was improvement in FIM score. We show that the group of patients who have low FIM gain ($\leqslant 13$) had significantly poorer survival compared with those who had high FIM gain (>13). We did not find that the FIM score on admission was a significant prognostic factor. From this study, it appears that the improvement in function, rather than the baseline function on admission, is related to survival; this further supports the important role of rehabilitation in improving functional independence.

Other variables we examined did not have predictive strength for survival. The ASIA score, age, level of lesion, length of rehabilitation, and gender did not reach significance as prognostic factors. The factor of surgical treatment of MSCC was not significant in this study. This may be due to inclusion of radiosensitive tumors, such as multiple myeloma, lymphoma, breast and prostate, which are most likely to decrease in size with radiotherapy.[15] Patients with multiple myeloma or lymphoma were excluded in the study by Patchell *et al*,[2] which showed combination treatment with surgery and radiotherapy was superior to radiotherapy alone.

Tokuhashi score and length of stay were associated with high FIM gain. Greater FIM improvement from longer length of stay is not surprising, given that a longer rehabilitation course allows more time for the team to work on achieving functional goals. Larger

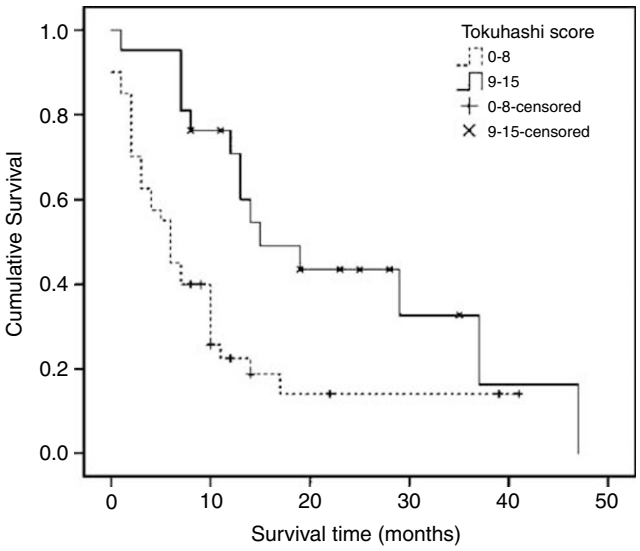

Figure 2 Kaplan–Meier survival curves for MSCC patients with Tokuhashi score 0–8 *versus* 9–15

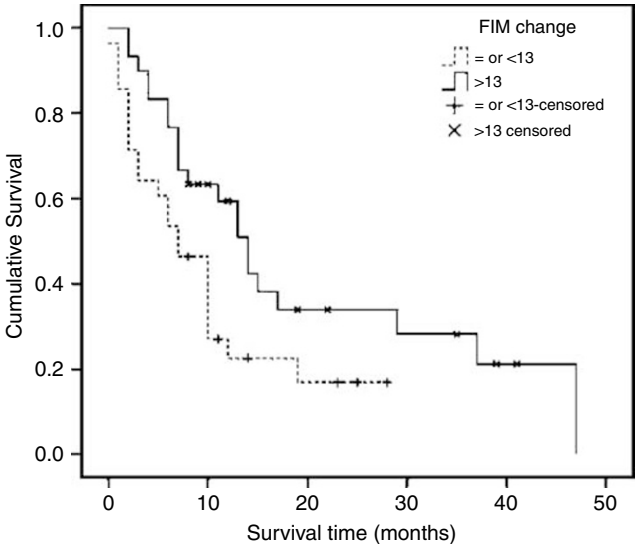

Figure 3 Kaplan–Meier survival curves for MSCC patients with FIM change $\leqslant 13$ *versus* >13

Table 5 Cox regression analysis

	Exp(B)	*95% CI*	P-*value*
FIM change	0.478	0.257–0.889	0.02
Tokuhashi score	0.392	0.200–0.769	0.006

$\chi^2 = 13.412$, df = 2 and P (model) = 0.001

functional gains in nontraumatic spinal cord lesions were associated with lower disability on admission, a shorter time from onset of symptoms to rehabilitation and a longer course of rehabilitation.[16] Factors affecting functional gains in rehabilitation of incomplete spinal cord pathology due to cervical myelopathy and intrinsic cord abnormalities, included length of stay in the rehabilitation unit and neurological improvement.[17] Better functional outcomes in spinal cord injury secondary to neoplasia were associated with less severe neurologic injuries.[18] Further studies are needed to evaluate factors contributing to high functional gain in MSCC.

Using the Tokuhashi scale on admission to rehabilitation may help identify those with the greatest potential for improvement in the rehabilitation program and likelihood of longer survival. Encouraging rehabilitation specialists to note the Tokuhashi score at the start of the rehabilitation treatment may help guide goal setting for individual patients. Those with a higher Tokuhashi score may be targeted for a more intensive and longer course of rehabilitation, as they have the greatest chance for functional improvement, while a shorter course aimed at early discharge can be offered to patients with poorer prognosis based on the Tokuhashi scale. Also, the Tokuhashi scale can aid in the screening of patients who may be unsuitable for rehabilitation, in addition to the standard criteria of medical stability, level of motivation and cognitive ability to participate in therapy. Three patients with spinal metastases died on our rehabilitation ward and they all presented with unresectable major organ metastases, three or more vertebral metastases, and a score of 5 or less on the Tokuhashi scale. Given that there were a few deaths on the ward, it suggests that our rehabilitation program has not turned away patients who are in need of rehabilitation and would benefit from our program. Further studies may help to select more accurately and to determine who would benefit from rehabilitation and who would benefit from palliative care.

One limitation of the study was the short follow up on the patients, as 15 out of the 63 patients were alive at the conclusion of the data collection. Certainly, it would be very useful to re-assess the status of the patients in 1 year's time. In spite of that, we were able to gather important data about both the living and deceased patient populations. Another limitation was that this study was retrospective. Without prospective data, we cannot definitively conclude the relationships as causative nor comment on the reliability of their predictive strength in prospective patients. Also, the rehabilitation program clearly integrates the expertise of various disciplines. We did not study whether certain types of interventions were more beneficial for functional improvement: for example, strength training, range of motion exercises, stretching exercises, practice in the activities of daily living or cardiovascular training. It would be useful to explore the effectiveness of these various exercise interventions in the future.

Rehabilitation in traumatic spinal cord injury patients has been more extensively studied in the past. Despite the differences in demographics, mechanism of injury and prognosis between the traumatic and neoplastic populations, we can learn valuable information about rehabilitation interventions that have been effective in

traumatic spinal cord injury. This retrospective study has set the groundwork for future studies involving rehabilitation interventions in those with MSCC, by providing information that can help us determine suitable patients for longer term interventions.

Acknowledgements

We thank the American Academy of Neurology for the research grant that supported this study, Dr Raelene Kinlough-Rathbone for her comments and critique of the manuscript, and Dr Forough Farrokhyar for her valuable input for statistical analyses.

References

1 Schmidt MH, Klimo Jr P, Vrionis FD. Metastatic spinal cord compression. *J Natl Compr Canc Netw* 2005; **3:** 711–719.
2 Patchell RA *et al*. Direct decompressive surgical resection in the treatment of spinal cord compression caused by metastatic cancer: a randomised trial. *Lancet* 2005; **366:** 643–648.
3 Keith RA, Granger CV, Hamilton BB, Sherwin FS. The functional independence measure: a new tool for rehabilitation. *Adv Clin Rehabil* 1987; **1:** 6–18.
4 Stineman MG *et al*. The functional independence measure: tests of scaling assumptions, structure, and reliability across 20 diverse impairment categories. *Arch Phys Med Rehabil* 1996; **77:** 1101–1108.
5 McKinley WO, Huang ME, Brunsvold KT. Neoplastic versus traumatic spinal cord injury: an outcome comparison after inpatient rehabilitation. *Arch Phys Med Rehabil* 1999; **80:** 1253–1257.
6 Tokuhashi Y, Matsuzaki H, Oda H, Oshima M, Ryu J. A revised scoring system for preoperative evaluation of metastatic spine tumor prognosis. *Spine* 2005; **30:** 2186–2191.
7 Parsch D, Mikut R, Abel R. Postacute management of patients with spinal cord injury due to metastatic tumour disease: survival and efficacy of rehabilitation. *Spinal Cord* 2003; **41:** 205–210.
8 Eriks IE, Angenot ELD, Lankhorst GJ. Epidural metastatic spinal cord compression: functional outcome and survival after inpatient rehabilitation. *Spinal Cord* 2004; **42:** 235–239.
9 McKinley WO, Seel RT, Hardman JT. Nontraumatic spinal cord injury: incidence, epidemiology, and functional outcome. *Arch Phys Med Rehabil* 1999; **80:** 619–623.
10 McKinley WO, Seel RT, Gadi RK, Tewksbury MA. Nontraumatic *vs* traumatic spinal cord injury: a rehabilitation outcome comparison. *Am J Phys Med Rehabil* 2001; **80:** 693–699.
11 McKinley WO, Tewksbury MA, Mujteba NM. Spinal stenosis *vs* traumatic spinal cord injury: a rehabilitation outcome comparison. *J Spinal Cord Med* 2002; **25:** 28–32.
12 Ulmar B, Richter M, Cakir B, Muche R, Puhl W, Huch K. The Tokuhashi score: significant predictive value for the life expectancy of patients with breast cancer with spinal metastases. *Spine* 2005; **30:** 2222–2226.
13 Enkaoua EA, Doursounian L, Chatellier G, Mabesoone F, Aimard T, Saillant G. Vertebral metastases: a critical appreciation of the preoperative prognostic Tokuhashi score in a series of 71 cases. *Spine* 1997; **22:** 2293–2298.
14 Obert L *et al*. Centromedullary nailing of the femur for bone metastasis: clinical and radiological evaluation using the Tokuhashi score in 24 patients. *Rev Chir Orthop Reparatrice Appar Mot* 2005; **91:** 737–745.
15 Mut M, Schiff D, Shaffrey ME. Metastasis to nervous system: spinal epidural and intramedullary metastases. *J Neuro-Oncol* 2005; **75:** 43–56.
16 Van der Putten JJ, Stevenson VL, Playford ED, Thompson AJ. Factors affecting functional outcome in patients with nontraumatic spinal cord lesions after inpatient rehabilitation. *Neurorehabil Neural Repair* 2001; **15:** 99–104.
17 Stevenson VL, Playford ED, Langdon DW, Thompson AJ. Rehabilitation of incomplete spinal cord pathology: factors affecting prognosis and outcome. *J Neurol* 1996; **243:** 644–647.
18 Murray PK. Functional outcome and survival in spinal cord injury secondary to neoplasia. *Cancer* 1985; **55:** 197–201.