

ORIGINAL ARTICLE

Traumatic vs non-traumatic spinal cord lesions: comparison of neurological and functional outcome after in-patient rehabilitation

A Gupta¹, AB Taly², A Srivastava¹, S Vishal¹ and T Murali¹

¹Department of Psychiatric & Neurological Rehabilitation, National Institute of Mental Health and Neuro Sciences (NIMHANS), Bangalore, Karnataka, India and ²Department of Neurology, National Institute of Mental Health and Neuro Sciences (NIMHANS), Bangalore, Karnataka, India

Study design: Retrospective comparative study of 2 years duration.

Objectives: To compare neurological and functional outcome and length of stay of persons with traumatic vs non-traumatic spinal cord lesion (SCL) after in-patient rehabilitation.

Setting: Neurological rehabilitation department of a tertiary research center in Bangalore, Karnataka, India.

Methods: Seventy-six in-patients with spinal cord lesion: traumatic (38 patients, M/F = 34:4) and non-traumatic (38 patients, M/F = 16:22) were admitted for in-patient multidisciplinary neurorehabilitation. ASIA impairment scale, duration of stay (DOS), and admission and discharge—Barthel Index scores in both the groups were recorded, compared and analyzed.

Results: ASIA impairment scale scores were significantly higher in non-traumatic group both at admission and discharge ($P=0.020$ and 0.017), respectively, showing lesser impairment in non-traumatic group. DOS for rehabilitation was higher for traumatic group as compared to non-traumatic group (65.97 ± 47.66 vs 60.68 ± 45.69 days), although statistically not significant ($P>0.05$). Barthel Index scores were 28.68 ± 17.15 vs 27.63 ± 14.96 at admission and 54.21 ± 25.10 vs 51.44 ± 19.86 at discharge in traumatic and non-traumatic groups, respectively. All patients ($n=76$) showed significant improvement in Barthel Index ($P=0.000$), but no statistically significant difference ($P>0.05$) was recorded between the two groups, both at admission and at discharge. Orthoses was required significantly more frequently ($P=0.043$) in traumatic SCL group.

Conclusions: The study showed that despite more impairment in persons with traumatic spinal cord lesion, there was statistically no significant difference in the length of stay and the functional outcome between persons with traumatic and non-traumatic spinal cord lesion after in-patient rehabilitation.

Spinal Cord (2008) 46, 482–487; doi:10.1038/sj.sc.3102168; published online 29 January 2008

Keywords: ASIA impairment scale; Barthel Index; length of stay; traumatic and non-traumatic SCL

Introduction

Spinal cord lesions (SCL) can be associated with significant functional impairment in the areas of mobility, self-care, bowel and bladder management, and sexuality.¹ Traumatic SCL occurs primarily in young adults with more than half being between 16 to 30 years of age. Men account for about 80% of cases.²

Non-traumatic SCL represents a significant proportion of individuals admitted for SCL rehabilitation.³ Non-traumatic SCLs have varied etiologies like spinal stenosis, primary and metastatic tumors, ischemia, infection and congenital diseases.^{4–7} Annual incidence of non-traumatic SCL may be as high as 8 per 100 000.⁸

Previous studies have revealed that non-traumatic SCL patients are older, more often married, female, retired, paraplegic and with incomplete injuries, compared with persons with traumatic SCL.^{9–12}

This study was conducted to compare the functional outcomes, demographic profiles and neurological recovery between traumatic and non-traumatic SCL in our setup.

Methods

This retrospective study analyzed medical records of patients with traumatic or non-traumatic SCL who were admitted in neurological rehabilitation facility over a period of 2 years (from September 2005 to July 2007). During this period, a total of 92 new patients with myelopathy were admitted in the department. Sixteen patients who expired, required transfer to other centers for medical attention during their

Correspondence: Dr A Gupta, Department of Psychiatric & Neurological Rehabilitation, National Institute of Mental Health and Neuro Sciences (NIMHANS), Hosur Road, Bangalore 560029, Karnataka, India.
 E-mail: anupam@nimhans.kar.nic.in
 Received 5 September 2007; revised 6 December 2007; accepted 15 December 2007; published online 29 January 2008

hospital stay and patients with tetraplegia with motor level above D1 with inability to hold assistive devices with hands were excluded from the study. Thus, 76 patients were enrolled for the study, 38 each in traumatic and non-traumatic group. Their demographic profile, socioeconomic status, education and occupation were compared and analyzed. ASIA impairment scale and Barthel Index (BI) score at admission were compared with their at-discharge scores. Duration of stay (DOS) in both the groups was also compared and analyzed.

Analysis

It was done using SPSS 11.0 version. Student *t*-test (paired *t*-test) was used for continuous variables like LOS, Barthel

scores, illness duration and age. Independent *t*-test was used to compare between two groups of traumatic and non-traumatic SCL. χ^2 test was used to compare other demographic profiles like gender, socioeconomic status, education and occupation. χ^2 test was also used for comparison of ASIA impairment scale and requirement of orthosis in both the groups. The two-tailed level of significance was kept at 0.05.

Results

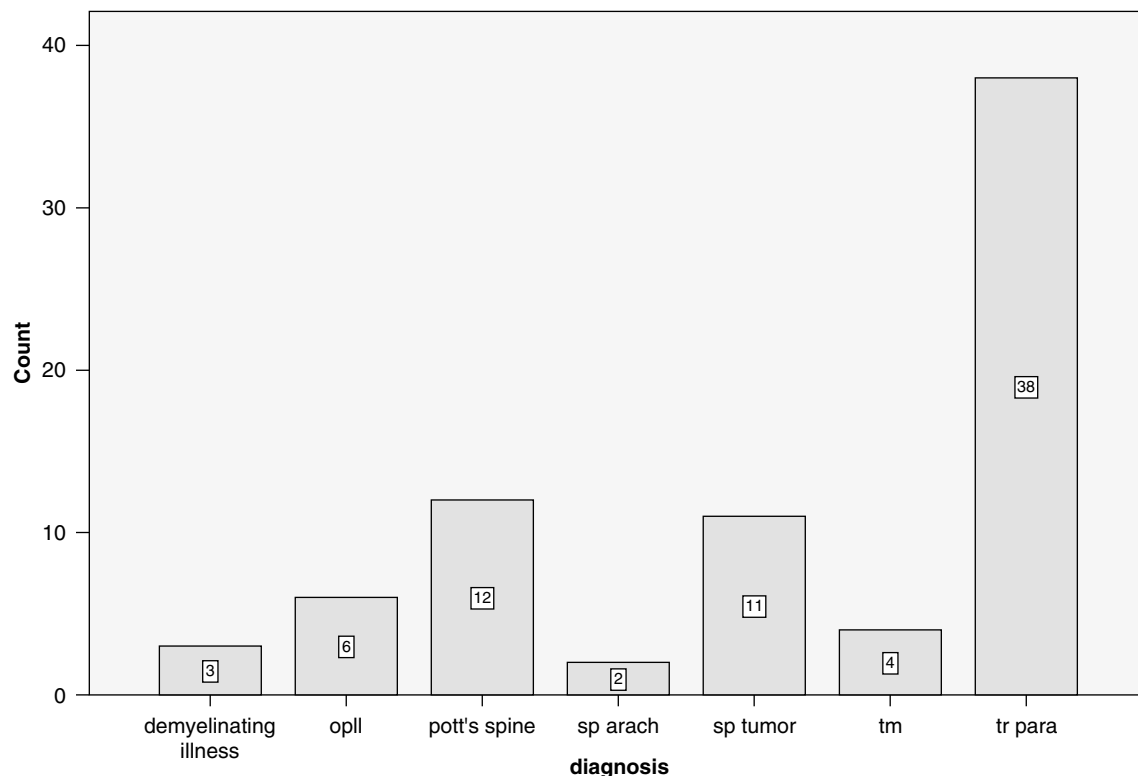
Seventy-six patients were included in the study, 38 each in traumatic and non-traumatic SCL group. Significant gender difference ($P < 0.05$) was noted between the groups with considerably more women in the non-traumatic SCL group (Table 1).

Mean age in traumatic SCL group was 32.86 ± 7.95 years and in the non-traumatic SCL group, it was 31.10 ± 14.35 years. It was statistically insignificant between the groups ($P = 0.510$). Etiology of SCL in both the groups is shown in Figure 1.

Duration since lesion was compared in both the groups. In traumatic SCL group, the duration of lesion ranged from

Table 1 Sex ratio in the study

	Clinical diagnosis		Total
	Traumatic myelopathy	Non-traumatic myelopathy	
Sex			
Male	34	16	50
Female	4	22	26
Total	38	38	76



opl: Ossified Posterior Longitudinal Ligament

sp arach: Spinal Arachnoiditis

sp tumor: Spinal Tumors

tm: Transverse Myelitis

tr para: Traumatic Paraplegia

Figure 1 Etiology of myelopathies.

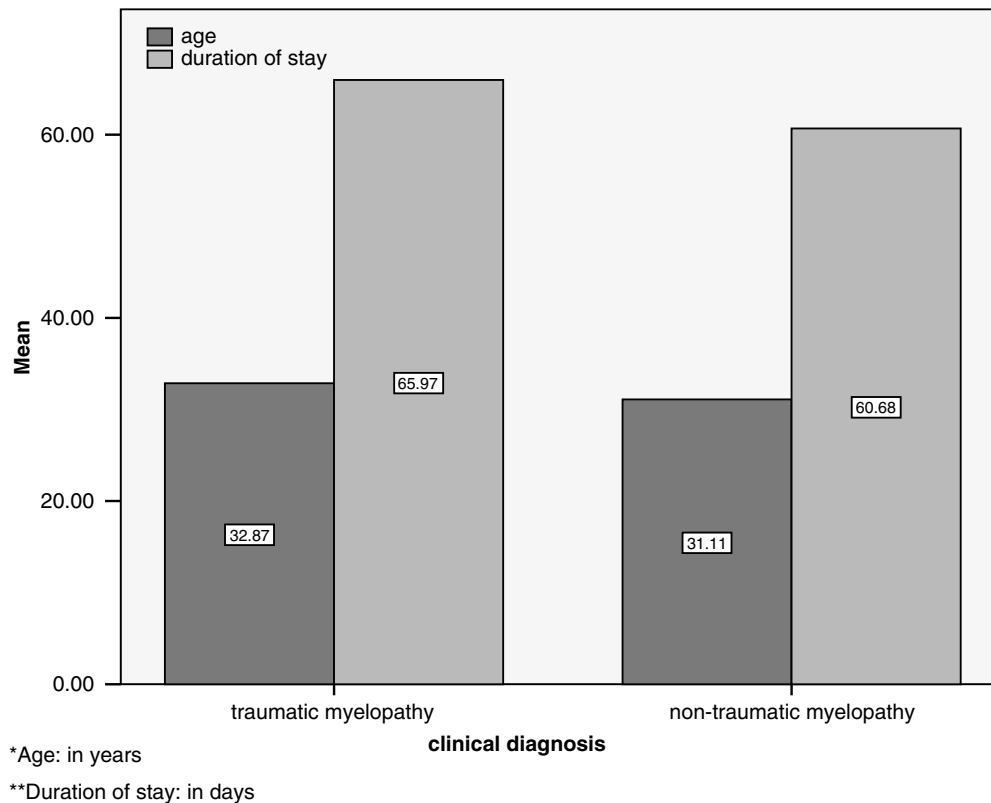


Figure 2 Comparison of duration of stay (DOS) in rehabilitation and age in traumatic and non-traumatic spinal cord lesion (SCL) groups.

1–16 months (4.97 ± 4.01), whereas in non-traumatic SCL group it varied from 1–36 months (5.68 ± 6.80). However, this difference was not significant ($P=0.581$). In traumatic and non-traumatic SCL groups, number of married patients (28 vs 25) outnumbered unmarried/single patients (10 vs 13). Comparing the both groups, it was statistically insignificant ($P>0.05$). Similarly, comparing the socioeconomic status in both the groups, 96.05% patients (73/76) belonged to low socioeconomic group with monthly wages less than Rs 3000 per month. Difference between the groups was insignificant ($P>0.05$).

Literacy status was compared in both the groups. Twenty patients from traumatic SCL were illiterate as against 21 patients from non-traumatic SCL group. Although this trend shows high illiteracy rate among sufferers, it was statistically insignificant ($P>0.05$) between the groups. Majority of the patients were living in the nuclear family (30 vs 30) and in the rural areas (31 vs 27) in traumatic and non-traumatic SCL groups, which again was statistically insignificant ($P>0.05$) while comparing both the groups. The vocation of the patients in both the groups varied widely. In the traumatic SCL group, there were 4 agriculturist, 12 unskilled laborers, 14 skilled laborers, 2 businessmen, 1 housewife and 5 were in other professions. Among non-traumatic SCL group, there were 4 agriculturist, 3 unskilled laborers, 13 skilled laborers, 2 businessmen, 7 housewives and 9 were involved in other professions.

Duration of stay (DOS) in the rehabilitation department was compared between the traumatic and non-traumatic

SCL groups (Figure 2). Mean DOS in the former group was 65.97 ± 47.66 days and in the latter group it was 60.68 ± 45.69 days. It was found statistically insignificant between the groups ($P>0.05$).

Upper level of lesion (according to magnetic resonance imaging scan) was compared between the groups. In traumatic SCL group, 5 patients had lesion above D6, 22 had lesion between D7 to D12 and 11 patients with highest level of lesion in the lumbar region (L1-4). In non-traumatic SCL group, 15 patients had upper level of lesion above D6, 20 patients had lesion between D7 to D12 and 3 patients had upper level lesion in the lumbar region (L1-2).

Assessment of functional outcome of rehabilitation was done using BI scale at the time of admission and discharge, with improvement in score at the time of discharge denoting improvement in functional abilities of the patient. Mean BI score were 28.68 ± 17.15 vs 27.63 ± 14.96 in traumatic and non-traumatic SCL group, respectively, at the time of admission. At-discharge score increased to 54.21 ± 25.10 vs 51.44 ± 19.86 in both the groups, showing significant improvement in functional abilities. While comparing between the groups, it was found insignificant ($P>0.05$) (Table 2).

American Spinal Injury Association (ASIA) scale was used for assessment of impairment in all the patients in both the groups (Table 3). Recordings were made at the time of admission in the neurorehabilitation department as well as at discharge. Scores were compared and analyzed in both the groups. ASIA scale scores were significantly higher in

Table 2 Group statistics

Clinical diagnosis	N	Mean	s.d.
<i>Age (years)</i>			
Traumatic myelopathy	38	32.8684	7.95314
Non-traumatic myelopathy	38	31.1053	14.35983
<i>Duration of stay (days)</i>			
Traumatic myelopathy	38	65.9737	47.66691
Non-traumatic myelopathy	38	60.6842	45.69943
<i>Family size</i>			
Traumatic myelopathy	38	4.8684	1.89125
Non-traumatic myelopathy	38	5.1316	1.93364
<i>Barthel Index admission</i>			
Traumatic myelopathy	38	28.6842	17.15132
Non-traumatic myelopathy	38	27.6316	14.96558
<i>Barthel Index discharge</i>			
Traumatic myelopathy	38	54.2105	25.10858
Non-traumatic myelopathy	38	51.4474	19.86127

Table 3 ASIA impairment score comparison at admission and at discharge between the traumatic and non-traumatic spinal cord lesion (SCL) groups

	ASIA impairment score									
	Admission score					Discharge score				
	A	B	C	D	E	A	B	C	D	E
Traumatic SCL	19	5	12	2	0	17	2	12	7	0
Non-traumatic SCL	11	6	9	12	0	6	4	11	17	0
Total	30	11	21	14	0	23	6	23	24	0

non-traumatic SCL group at admission ($P=0.020$) and at discharge ($P=0.017$) as compare with traumatic SCL group, meaning thereby patients in latter group had more impairment both at the time of admission and at discharge from rehabilitation.

Analysis for requirement of orthosis (not assistive devices) was also done between the groups. In traumatic SCL group, 33 patients required orthosis for ambulation (therapeutic/functional), whereas in non-traumatic SCL group, 25 patients required orthosis for ambulation. So requirement of orthosis was significantly higher ($P<0.05$) in traumatic SCL group.

At the time of discharge, 22 (57.90%) patients in traumatic SCL group were using wheel chair as their primary means of mobility and 16 (42.10%) patients were using orthosis and assistive devices (walker, crutches or cane) for locomotion. In the non-traumatic SCL group, 14 (36.84%) patients were using wheel chair for mobility and 24 (63.16%) patients were able to walk using orthosis and assistive devices.

Discussion

This retrospective study involved myelopathy patients, admitted in neurological rehabilitation over a period of 2

years. Medically stabilized patient who can participate in active rehabilitation are more often admitted, so most of the patients in traumatic SCL belong to thoracic or lumbar level lesion and not cervical in this study. In non-traumatic group also similar trend can be seen with most of the patients having thoracic and lumbar lesion. This is understandable as common spinal site for lesions like Pott's Spine (most common etiology found in the study among non-traumatic SCL group) is dorsolumbar region. Spinal tumors, which were the next most common etiology in non-traumatic group in this study, involve the thoracic and lumbar regions more than cervical regions.^{13–15}

Contrary to the earlier study by McKinley *et al.*¹ in 2000 recording significant age difference of traumatic SCL with neoplastic SCL, no significant age difference was found in this study between both the groups ($P>0.05$), as the mean age was 32.86 ± 7.95 years in traumatic group and 31.10 ± 14.35 years in non-traumatic SCL group. It can be explained on the basis that in this study most of the neoplastic spinal tumors were primary, afflicting the patient at much earlier age compare with secondary metastasis, which is a late phenomenon. As observed in earlier studies also, traumatic SCL affects persons at young age group with 50% of the patients are from 16–30 years age group.²

Gender difference was found between both the groups with significantly more women ($P<0.05$) found in non-traumatic SCL group as compare with traumatic SCL group (22 vs 4). Earlier study by McKinley *et al.*¹ in 2000 have also shown the same trend. This can be understood on the basis that most common cause of traumatic SCL, which is road traffic accident. Most of persons driving vehicles are men, especially in rural areas and drink-driving, which is much more common with men and rare with women, so men predominantly succumb to traumatic SCL. In non-traumatic SCL group, women outnumbered men. This is understandable as most of the lesions in non-traumatic SCL group like Pott's Spine, tumors and ossified posterior longitudinal ligaments causing compressive myelopathy are related with factors like hygiene, contact with affected person, genetic or hereditary factors and water supply in the area and are not gender based. These factors show much less gender difference.

No significant difference between the groups was found for socioeconomic status, education and marital status ($P>0.05$) with 96.05% patients in the study belonging to low socioeconomic status, 85.5% patients were illiterate or only primary educated ($n=76$).

The ASIA protocol describes a standardized clinical examination of motor and sensory functions in cases of traumatic SCL.¹⁶ It has been used for assessment in the cases of ischemic SCL also. ASIA impairment scale was used with traumatic and non-traumatic SCL in this study both at admission and at discharge. While comparing between the group, it was found that the score were significantly higher in non-traumatic group both at admission and at discharge as compared to traumatic SCL group ($P=0.020$ & $P=0.017$), thereby meaning that impairment was more in traumatic SCL group at the time of admission for rehabilitation and at discharge. The same trend has been observed in the earlier

studies also. Non-traumatic SCL tends to be associated with more incomplete injuries.^{7,10,11,17} Epidural compression is the most common presentation for spinal cord tumors. Most patients present at the onset of weakness with bladder or bowel symptoms, and treatment with radiation or surgery as well as chemotherapy may allow them to maintain incomplete injury status at presentation to the rehabilitation unit.¹ In Pott's Spine cases also, most of the cases admitted in rehabilitation have incomplete cord lesion picture. As these patients also get conservative management in the form of anti-tubercular treatment alone or with surgical decompression with stabilization of spine by the time they come for rehabilitation, they show good recovery neurologically, functionally with control of bladder by the time they are discharged from rehabilitation.¹⁸

Duration of stay in rehabilitation as outcome measure of rehabilitation was compared between the groups and analyzed. No significant difference was found between the groups ($P > 0.05$) in the study. McKinley *et al.*³ revealed in their study that non-traumatic SCL patients had a shorter rehabilitation DOS than those with Traumatic SCL. According to the authors, factors potentially influencing longer DOS in traumatic SCL patients include treatment issues associated with traumatic injuries (for example, chest trauma, gunshot wound and fractures) and medical complications. In our study, most of the patients at the time of admission were medically stable and in a position to actively participate in rehabilitation. In both the groups, the ultimate goal was to make them functionally independent and attain therapeutic/functional ambulation at the time of discharge. It could be because of these goals that DOS was insignificant between groups.

Barthel Index scores at the time of admission and discharge were recorded and used as functional outcome measure comparison between the groups. All studies published so far in literature have used Functional Independence Measure (FIM) scores or FIM motor subscore for comparison of functional outcome measure between traumatic and non-traumatic SCL groups.^{3,19} This is the first study using BI score for the same purpose. Nyein *et al.*²⁰ in their study have established that the BI score can be derived by translation from the FIM motor subscore and it equate to the directly scored measure (BI). This means that it is as sensitive an indicator as FIM motor subscore of the functional outcome measure regarding functional recovery/deterioration of the affected patients.

Mean BI admission score was marginally high in traumatic SCL group. The same trend was noted in at-discharge scores with higher mean scores for traumatic SCL group. Both groups (within each group) showed significant improvement in their Barthel score at discharge ($P = 0.000$) when compare with at-admission scores. But difference between the groups (intergroup) was insignificant ($P > 0.05$). All studies done earlier have used FIM as functional outcome measure after rehabilitation. Although different scale was used in the earlier studies, the trend was same with patients in both the groups, showing significant functional improvement at discharge, but difference between both the groups (intergroup) was insignificant.^{1,16} One study published

earlier showed statistically significant difference in at-discharge scores between the groups.¹⁹

The comparable BI scores between the two groups shows that in spite of having different etiologies, patients in both the groups showed similar and significant rates of functional improvement during their rehabilitation stay in the hospital.

Orthoses were more frequently required in traumatic SCL group ($P = 0.043$). Despite this, no significant difference was observed in functional outcome measures between the groups. This can be explained on the basis of ASIA scores in both the groups at admission. In traumatic SCL group, 24 patients (63.15%) were in either A or B group, whereas in non-traumatic SCL group only 17 patients (44.73%) were in the same groups. As patients in traumatic SCL group had more impairment, requirement of orthosis was more in this group. This could also be because of small sample size in the study.

Limitations of the study

This study has limited sample size and records were available for only 2 years duration. Larger sample size followed over a longer duration may give better understanding about comparison between the traumatic and non-traumatic SCL groups. There was a selection bias in this study as patients with cervical lesions who were not able to actively participate in rehabilitation program were excluded. Patients were not stratified based on spinal levels, since the primary aim of the study was to compare traumatic with non-traumatic group.

Conclusion

The study has shown that in spite of more impairment in persons with traumatic SCL, there was no statistically significant difference in DOS and functional outcome between persons with traumatic and non-traumatic SCL after in-patient rehabilitation.

References

- McKinley WO, Huang M, Tewksbury MA. Neoplastic vs traumatic spinal cord lesion: an inpatient rehabilitation comparison. *Am J Phys Med Rehabil* 2000; **79**: 138–144.
- Go BK, DeVivo MJ, Recharts JS. The epidemiology of spinal cord lesion. In: Stover SL, Delisa JA, Whiteneck GG (eds). *Spinal Cord Lesion*. Aspen: Gaithersburg, MD, 1995, pp 21–25.
- McKinley WO, Seel RT, Gadi RK, Tewksbury MA. Nontraumatic vs traumatic spinal cord lesion: a rehabilitation outcome comparison. *Am J Phys Med Rehabil* 2001; **80**: 693–699.
- Adams RD, Salam-Adams M. Chronic non-traumatic diseases of the spinal cord. *Neurol Clin* 1991; **9**: 605–623.
- Dawson DM, Potts F. Acute non-traumatic myelopathies. *Neurol Clin* 1991; **9**: 585–602.
- Schmidt RD, Markovchick V. Nontraumatic spinal cord compression. *J Emerg Med* 1992; **10**: 189–199.
- Byrne TN, Waxman SG. *Spinal Cord Compression: Diagnosis and Principles of Treatment: Contemporary Neurology Series*. Davis: Philadelphia, FA, 1990.
- Kurtzke JF. Epidemiology of spinal cord lesion. *Exp Neurol* 1975; **48**: 163–236.
- McKinley WO, Tellis AA, Cifu DX, Johnson MA, Kubal WS, Keyser-Marcus L *et al*. Rehabilitation outcome of individuals with non traumatic myelopathy resulting from spinal stenosis. *J Spinal Cord Med* 1998; **21**: 131–136.

- 10 McKinley WO, Conti-Wyneken AR, Vokac CW, Cifu DX. Rehabilitative functional outcome of patients with neoplastic spinal cord compression. *Arch Phys Med Rehabil* 1996; **77**: 892–895.
- 11 McKinley WO, Seel R, Hardman J. Nontraumatic spinal cord lesion: incidence, epidemiology and functional outcome. *Arch Phys Med Rehabil* 1998; **79**: 1186–1187.
- 12 McKinley WO, Huang M, Tewksbury MA. Neoplastic vs traumatic spinal cord lesion: an inpatient rehabilitation comparison. *Am J Phys Med Rehabil* 2000; **79**: 138–144.
- 13 Kim RY, Spencer SA, Meredith RF, Weppelmann B, Lee JY, Smith JW *et al*. Extradural spinal cord compression: analysis of factors determining functional prognosis-prospective study. *Radiology* 1990; **176**: 279–282.
- 14 Helweg-Larsen S. Clinical outcome in metastatic spinal cord compression: a prospective study of 153 patients. *Acta Neurol Scand* 1996; **94**: 269–275.
- 15 Leviov M, Dale J, Stein M, Ben-Shahar M, Ben-Arush M, Milstein D *et al*. The management of metastatic spinal cord compression: a radiotherapeutic success ceiling. *Int J Radiat Oncol Biol Phys* 1993; **27**: 231–234.
- 16 Ditunno Jr JF, Young W, Donovan WH, Creasey G. The international standards booklet for neurological and functional classification of spinal cord injury. American Spinal Injury Association. *Paraplegia* 1994; **32**: 70–80.
- 17 Hall KM, Johnston MV. Outcome evaluation in traumatic brain injury rehabilitation. Part II. Measurement tools for a nationwide data system. *Arch Phys Med Rehabil* 1994; **75**: SC10–SC18.
- 18 Sai Kiran NA, Vaishya S, Kale SS, Sharma BS, Mahapatra AK. Surgical results in patients with tuberculosis of the spine and severe lower-extremity motor deficits: a retrospective study of 48 patients. *J Neurosurg Spine* 2007; **6**: 320–326.
- 19 Ones K, Yilmaz E, Beydogan A, Gultekin O, Caglar N. Comparison of functional results in non-traumatic and traumatic spinal cord lesion. *Disabil Rehabil* 2007; **29**: 1185–1191.
- 20 Nyein K, McMichael L, Turner-stokes L. Can a Barthel score be derived from the FIM. *Clin Rehabil* 1999; **13**: 56–63.