

Pattern and Outcome of Traumatic Spinal Cord Injury Managed at University of Maiduguri Teaching Hospital, Nigeria: A Retrospective Study

Cornelius Mahdi Ishaku¹, Buba Kabaju Jawa¹, Stanley Monday Maduagwu^{1,2}, Auwal Bello Hassan¹, Aliyu Lawan¹, Adamu Ahmad Rufa'i¹, Adetoyeje Yoonus Oyeyemi¹

¹Department of Medical Rehabilitation (Physiotherapy), Faculty of Allied Health Sciences, College of Medical Sciences, University of Maiduguri, Maiduguri, Borno State, ²Department of Medical Rehabilitation, Faculty of Health Sciences and Technology, College of Health Sciences, Nnamdi Azikiwe University, Awka, Nnewi Campus, Anambra State, Nigeria

Abstract

Background: Understanding pattern and outcome of traumatic spinal cord injury (TSCI) will inform better management which expectedly would improve prognosis and minimise complications. **Methods:** A retrospective study was carried out on all managed TSCI cases from January 2009 to December 2018. Sociodemographic characteristics, injury type, cause and complications were extracted from patients' registers and case folders. Descriptive statistics summarised the data, and Fisher's exact test analysed associations between variables. **Results:** Eighty-one cases met the inclusion criteria and were analysed. Most cases (91.4%) were males, aged 18–39 years (65.4%) and were civil servants (37.0%). Road traffic accident (RTA) was the leading cause of injury (37.0%) and incomplete lesion predominated (69.1%). Cases referred for physiotherapy constituted 77.8%, only 14.8% of cases recovered without neurological deficits. On discharge, most patients were wheelchair bound (33.3%). Region of spine affected showed significant association with complications developed ($P = 0.01$). RTA caused more dead as a cause of injury was found to be significantly associated with outcome ($P = 0.04$). Referral for physiotherapy showed significant association with outcome ($P = 0.01$), so also, region of spine affected with outcome ($P = 0.01$). The study found a significant association between type of injury and functional status ($P = 0.01$). **Conclusions:** The study concludes that young adults of working class were mostly affected, and RTA and gunshots injuries were the leading causes of TSCI. Findings such as the association found between regions of spine affect and complication developed on admission will help healthcare providers identify those susceptible and offer prompt preventive measures.

Keywords: Bedsore, road traffic accident, spinal cord, trauma

INTRODUCTION

Traumatic spinal cord injury (TSCI) is associated with morbidity, deformity and mortality, leaving its victim with varying degree of dependency, emotional and economic burden.^[1,2] It occurs as a result of insult to the cord within the vertebral column, which leads to either temporary or permanent neurological and functional deficits.^[3] Studies^[3-6] have shown that males especially those within economically productive age group are the most affected. Furlan *et al.*^[7] in a study on global incidence and prevalence of TSCI identified road traffic accidents (RTAs), gunshots, falls and sport injuries as the

common causes of TSCI. Early studies^[5,8,9] have shown that cervical spine is the most affected region, with most patients presenting with either quadriplegia or quadriparesis depending on the severity of injury.^[10] Globally, the annual incidence rate of TSCI is between 10.4 and 83 per million people,^[11] with variations seen across developed and developing nations. Liu *et al.*^[12] in 2016 reported that about 39 and 16 million people

Address for correspondence: Mr. Cornelius Mahdi Ishaku, Department of Medical Rehabilitation (Physiotherapy), Faculty of Allied Health Sciences, College of Medical Sciences, University of Maiduguri, Maiduguri, Borno State, Nigeria. E-mail: corniez10@gmail.com

Received: 24-10-2020,

Revised: 29-11-2020,

Accepted: 09-02-2021,

Published: 03-09-2021

Access this article online

Quick Response Code:



Website:
www.npmj.org

DOI:
10.4103/npmj.npmj_345_20

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

How to cite this article: Ishaku CM, Jawa BK, Maduagwu SM, Hassan AB, Lawan A, Rufa'i AA, *et al.* Pattern and outcome of traumatic spinal cord injury managed at University of Maiduguri Teaching Hospital, Nigeria: A retrospective study. Niger Postgrad Med J 2021;28:139-44.

in North America and Western Europe, respectively, sustain TSCI each year. This high prevalence of TSCI reported in the aforementioned developed parts of the world contributes to the huge financial burden on costs of medical and rehabilitation services, psychological burden resulting from social isolation and reduced productivity.

In Nigeria, many sub-regional studies have been conducted on pattern and outcome of spinal cord injury (SCI).^[1,5,8,13] Although Umaru and Ahidjo^[8] studied the pattern of SCI in 2005 in the same region, this study looked at both pattern and outcome, and also examined the association existing between outcomes and type/cause of injury with more than a double sample size of the previous study. In addition, insurgency has been going on in the region since 2009 with numerous deadly attacks targeted at the people, leaving scores of deaths and injured. This leaves a lot of bomb blasts and gunshots injured victims seeking medical attention. Further, the frequent unease movements among dwellers seeking safety may lead to RTA. Therefore, the study was aimed at providing a sub-national data on pattern and outcome of TSCI cases seen and managed at University of Maiduguri Teaching Hospital.

MATERIALS AND METHODS

Study population and site

This retrospective study was conducted at University of Maiduguri Teaching Hospital to recruit both adult and paediatric cases of diagnosed TSCI seen and managed over a 10-year period between 1st January 2009 and 31st December 2018; however, no paediatric case was seen and managed within the timeframe the study covered.

Ethical approval and inclusion criteria

Research and Ethical Committee of University of Maiduguri Teaching Hospital approved the study (UMTH/REC/413) on 14th June 2019 before commencement. Permissions from the Heads of the Departments of Medical Records and Physiotherapy were sought to retrieve all records in registers and case folders of patients with TSCI. Case folders with neither X-ray nor magnetic resonance imaging (MRI) results or any clear diagnosis of TSCI were excluded. To avoid double entry since data were taken from two departments, and because some names are identical, we used hospital numbers. This also ensured that the identity of the patients were concealed. The hospital numbers so listed were not part of data analysis. We utilized both patients' registers and case folders at both departments of medical records, and physiotherapy for data collection to ensure omission of cases is at the barest minimum.

Data collection and procedure

Pro forma sheets were used to collect patients' data from folders and record books at both department of medical records and physiotherapy. All patients diagnosed of TSCI, seen and managed in the centre within the 10 years were covered. The following information was collected: sociodemographics, causes and types (complete or incomplete) of injury and

region of spine affected. Others included information on complications developed while on admission. Functional status on discharge, how patients recovered (outcome) and equipment needed on discharge were equally obtained.

Data analyses

Statistical analysis of frequency counts and percentages was used to describe categorical variables. Jung^[14] in his article on Fisher's exact test and its sample size calculation described that studies with sample size of 70 or subgroups with less than five counts can use Fisher's exact test to determine association. Therefore, since only 81 cases of TSCI were found recorded within the 10 years covered, Fisher's exact test was used to analyse the association between marital status and complications developed while on admission, level of education and complications developed while on admission, cause of injury and outcome, referral for physiotherapy and outcome, area of spine affected and complications developed while on admission, area of spine affected and outcome, area of spine affected and functional status on discharge, type of injury and functional status on discharge. Statistical significance was set at $P \leq 0.05$, using IBM Statistical Package for the Social Sciences (SPSS) for windows version 20, Armonk, New York, USA.

RESULTS

Eighty-one cases of TSCI retrieved from patients' registers and case folders that met the inclusion criteria for the study were used for data analysis. Overwhelming majority (91.4%) of the cases reviewed were males and those within the age group of 18–39 years were in predominance (65.4%). In level of education, cases of patients with TSCIs that attained secondary school predominated (34.6%), whereas in the occupational group, cases of this condition among civil servants constituted the majority (37.0%). In the same vein, the cases of TSCI were found to be most common (48.1%) among unmarried persons. Table 1 shows the detail of case distribution based on sociodemographics.

RTA was the leading cause (37.0%) of TSCI, incomplete lesion of the cord was more common (69.1%) and cases with cervical cord injury formed the majority (37.0%) [Table 2]. Patients who presented with bedsores as the only complication constituted 25.9% of cases seen, while cases with two or more complications accounted for 38.3%. Majority of the cases (42.0%) managed were discharged home with some neurological deficits, and most (33.3%) were wheelchair bound on discharge. A mortality rate of 13.6% was recorded while patients were on admission, while 16% of patients left against medical advice (LAMA). More than 75% of the reviewed cases were referred for physiotherapy. Table 2 illustrates the clinical characteristics of cases reviewed.

Fisher's exact test found no statistically significant association between marital status and complications developed while on admission; level of education and complication developed while on admission; region of spine affected and functional status

Table 1: Frequency distribution of cases of traumatic spinal cord injury based on sociodemographic variables

Variables	n (%)
Gender	
Male	74 (91.4)
Female	7 (8.6)
Age group (years)	
18-39	53 (65.4)
40-59	25 (30.9)
60 and above	3 (3.7)
Level of education	
No education	13 (16.0)
Primary education	3 (3.7)
Secondary education	28 (34.6)
Tertiary education	25 (30.9)
Quranic education	12 (14.8)
Occupation	
Student	9 (11.1)
Unemployed	13 (16.0)
Business	21 (25.9)
Farmers	8 (9.9)
Civil servants	30 (37.0)
Marital status	
Single	39 (48.1)
Married	33 (40.7)
Widow/widower	4 (4.9)
Divorce	5 (6.2)

n: Frequency

on discharge. However, a statistically significant association was found between region of spine affected and complications developed while on admission ($\chi^2 = 26.29$, $P = 0.01$), with bed sore being the most common single complication (11.1%) found among those with injury at the lumbar region. Worthy of note is that majority of the patients (21.0%) who presented with combination of two or more complications had spinal cord lesion at the cervical region [Table 3]. Cause of injury and outcome showed significant association ($\chi^2 = 24.07$, $P = 0.04$). It was observed that among patients who recovered with neurological deficits, gunshot is the leading cause of injury (13.6%). The study also showed that among the 13.6% of patients who died while on admission, 11.1% had TSCI through RTA. Findings from the study showed significant association between referral for physiotherapy and outcome ($\chi^2 = 38.37$, $P = 0.01$), it was observed that 14.8% of patients who recovered without neurological deficits were referred for physiotherapy.

The study also found significant association between region of spine affected and outcome ($\chi^2 = 23.01$, $P = 0.01$). It was found out that majority of patients (7.4%) who recovered without neurological deficits had spinal cord lesion at the level of the thoracic vertebrae. Most of the patients who died while on admission (12.3%) sustained their spinal cord lesion at the cervical vertebrae. Significant association was also seen between type of injury and functional status on discharge ($\chi^2 = 16.72$, $P = 0.01$), as it was observed that all

Table 2: Clinical characteristics of cases and referral for physiotherapy

Variables	n (%)
Cause of injury	
Gun shot	20 (24.7)
Fall	13 (16.0)
Road traffic accident	30 (37.0)
Stab	10 (12.3)
Bomb blast	8 (9.9)
Type of injury	
Complete	25 (30.9)
Incomplete	56 (69.1)
Region of spine affected	
Cervical	30 (37.0)
Thoracic	24 (29.6)
Lumbar	27 (33.3)
Complications on admission	
No complication	8 (9.9)
Bedsore	21 (25.9)
Incontinence	4 (4.9)
Contractures	3 (3.7)
Urinary tract infection	14 (17.3)
Combination of two or more	31 (38.3)
Outcome	
Not recovered	11 (13.6)
Recovered with neurological deficit	34 (42.0)
Recovered without neurological deficit	12 (14.8)
Leave against medical advice	13 (16.0)
Deceased	11 (13.6)
Functional status on discharge	
Wheelchair bound	27 (33.3)
Walking with aid	22 (27.2)
Walking unaided	8 (9.9)
Referral for physiotherapy	
Referred	63 (77.8)
Not referred	18 (22.2)

n: Frequency

patients with complete SCI (21.1%) who were discharged were wheelchair bound. Among those discharged with incomplete SCI, 38.6% were able to walk with walking aids, while 14.0% could walk without any form of walking aid.

DISCUSSION

This study aimed at providing information on pattern and outcome of TSCI managed at University of Maiduguri Teaching Hospital from the inception of insurgency in 2009–2018. The finding revealed that overwhelming majority of the cases with TSCI seen and managed at the health facility between that period were males. This corroborates the outcome of two previous studies in Nigeria^[5,8] and one other in Sierra Leone^[3] which reported male preponderance in cases of SCIs. The overwhelming numbers of male than female patients seen could be related to the nature of work males do in this part of the country which involves a lot of travels with risk of RTA. It could also be adduced that males generally are bread winners

Table 3: Association between variables

Variable	Complications (%)						χ^2	P
	No complication	Bedsore	Incontinences	Contractures	UTI	CC		
Cervical	0 (0.0)	4 (4.9)	2 (2.5)	1 (1.2)	6 (7.4)	17 (21.0)	26.29	0.01
Thoracic	2 (2.5)	8 (9.9)	1 (1.2)	0 (0.0)	8 (9.9)	5 (6.2)		
Lumbar	6 (7.4)	9 (11.1)	1 (1.2)	2 (2.5)	0 (0.0)	9 (11.1)		
Variable	Outcome (%)					χ^2	P	
	Not recovered	RWND	RWOND	LAMA	Deceased			
Gun shot	4 (4.9)	11 (13.6)	4 (4.9)	1 (1.2)	0 (0.0)	24.07	0.04	
Fall	1 (1.2)	6 (7.4)	2 (2.5)	3 (3.7)	1 (1.2)			
RTA	5 (6.2)	9 (11.1)	1 (1.2)	6 (7.4)	9 (11.1)			
Stabbed	1 (1.2)	3 (3.7)	3 (3.7)	3 (3.7)	0 (0.0)			
Bomb blast	0 (0.0)	5 (6.2)	2 (2.5)	0 (0.0)	1 (1.2)			
Variable	Outcome (%)					χ^2	P	
	Not recovered	RWND	RWOND	LAMA	Deceased			
Referral for physiotherapy								
Referred	11 (13.6)	32 (39.5)	12 (14.8)	2 (2.5)	6 (7.4)	38.37	0.01	
Not referred	0 (0.0)	2 (2.5)	0 (0.0)	11 (13.6)	5 (6.2)			
Region of spine affected								
Cervical	3 (3.7)	9 (11.1)	1 (1.2)	7 (8.6)	10 (12.3)	23.01	0.01	
Thoracic	4 (4.9)	12 (14.8)	6 (7.4)	1 (1.2)	1 (1.2)			
Lumbar	4 (4.9)	13 (16.0)	5 (6.2)	5 (6.2)	0 (0.0)			
Variable	Functional status on discharge (%)			χ^2	P			
	Wheelchair bound	Walking with aids	Walking unaided					
Complete SCI	12 (21.1)	0 (0.0)	0 (0.0)	16.72	0.01			
Incomplete SCI	15 (26.3)	22 (38.6)	8 (14.0)					

χ^2 : Fisher's exact test, UTI: Urinary tract infection, CC: Combination of complication, RWND: Recovered with neurological deficits, RWOND: Recovered without neurological deficits, LAMA: Leave against medical advice, RTA: Road traffic accident, SCI: Spinal cord injury

moving from place to place in search of means of livelihood for the family and self. Furthermore, in the part of Nigeria where this study was conducted, most women, based on some sociocultural and religious factors, stayed at home to care for the children and family at large, hence, they are not exposed to much risk of RTA as compared to their male counterparts.^[15] To cap it, RTAs and gunshots which are plausible male-driven circumstances by nature topped the list of causes of TSCI in our study.

Our study found that more than half of the cases of TSCI involved persons between the age group of 18 and 39 years. This finding is in tandem with that of 15 years retrospective study conducted in Southeastern Nigeria by Ibikunle and Okoro in 2018^[16] which showed that persons between the ages of 21 and 40 years top the list of those that sustained SCI in that study. This population seems to be the most economically buoyant and productive age group in any society and hence likely to be exposed to numerous physical activity related hazards or accidents which may encompass occupational, sports/recreational and transport. This study revealed that most cases of TSCI were civil servants and business persons with a minimum of secondary school and tertiary educations. The reason for this finding may be difficult to ascertain. However, it could be that this group of people constitutes the larger cohort of active population and are involved in travelling from one

place to another in the course of their duties. In addition, the economic meltdown which is taking its toll in Nigeria and coupled with the insurgency in this part of the nation may be a reason, especially for certificate holders who are searching for jobs from one place to another. Whatever the reasons for this occurrence, our finding however agrees with that of a study conducted in India by Kumar *et al.*,^[17] where most cases of TSCI involved persons considered literates and employed.

As reported in many previous studies,^[18-20] this study corroborated that RTA is the leading cause of TSCI, followed by gun shots and fall from height. This may not be unrelated to the persistent insurgent attacks that have been on-going in this part of the country for over a decade now, living lots of people most times running to seek refuge elsewhere. The study found out that 69.1% of cases are incomplete TSCI, which agree with what was seen in a retrospective study conducted in India^[20] where most presented injuries were found to be incomplete in nature. Previous studies^[10,19] revealed the most affected region of the spine to be cervical region, while some studies^[16,18] opined that thoracic spine is affected most frequent too. This study, however, corroborates with cervical region being most affected than other segments of the spine.

A profound number of cases seen and managed were referred for physiotherapy during the period of admission. Bedsore

was identified as the most occurring single complication seen among patients although about 38.3% of the patients presented with two or more combined complications on admission. At the point of discharge, the study revealed that only 14.8% of the patients recovered without any neurological deficit, while simple majority were discharged home with one neurological deficit or the other. This is consistent with the study conducted by Gosselin and Coppotelli,^[3] where they stated that most SCI patients ended up with either permanent or temporary neurological and functional deficits. Considering the large number of patients that ended up with neurological deficits, the study explored further and found out that 33.3% of the patients were wheelchair bound on discharge. This also corroborates with the study carried out by Kamrunnaher *et al.*,^[21] where majority of the patients were wheelchair bound on the time of discharge.

There was no substantial evidence from this study to prove an association existing between marital status, level of education and complications developed while on admission. Cause of injury, referral for physiotherapy and region of spine affected were significantly associated with outcome of the patients. This is, however, supported by a study conducted by Pandey *et al.*^[22] in India, where overall morbidity is reduced among SCI patients who had early rehabilitation sessions. It is also an established fact that patients with injuries at lower regions of the spine tend to ambulate and relatively live independently than those with injuries at the upper region of the spine. This study, however, did not find association between region of spine affected and the functional status of patients on discharge. A significant association was found between type of injury (complete or incomplete lesion) and functional status of patients on discharge, which agrees with the study conducted by Cowley *et al.*^[23] and Westgren and Levi^[24] where they stated that functional ability depends on severity and type of injury.

It is important to state some limitations of this study thus: first, the study considered only cases seen and managed within the 10 years the review covered and only few cases were found to meet the inclusion criteria. Second, data were collected from one centre, hence posing a generalization challenge. Third, this is a retrospective study where data were collected secondarily; no information was directly obtained from patients but from their folders and other records; thus, any information wrongly recorded might have affected the conclusions drawn by this study.

CONCLUSION AND RECOMMENDATION

The findings of this study indicated that young working-class adults are more predisposed to having TSCI due to RTA and gun shot. Even though there is high referral of these cases for physiotherapy, majority of the patients recovered with neurological deficit; further, the number of those with incomplete SCI cases bound to wheelchair was large to be ignored. This calls for more studies to be conducted to isolate the most predictive factors among those identified to be

significantly associated with outcome and functional status after discharge. This will sensitize healthcare givers to give more priority to those factors so as to maximize recovery of functions status after TSCI.

Acknowledgement

We sincerely appreciate the technical assistance offered by Dr Adewale Luqman Oyeyemi throughout the period of this study. Further, we want to thank most sincerely the heads of Physiotherapy and Medical Records, University of Maiduguri Teaching Hospital, for assisting us in having access to patients' records. Our heart goes out to all SCI patients all over the world!

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Kawu AA, Adebule GT, Gbadegesin SA, Alimi MF, Salami AO. Outcome of conservative treatment of spinal cord injuries in Lagos, Nigeria. *Niger J Orthop Trauma* 2010;9:21-3.
2. Chanu AR, Zonunsanga C, Hmingthanmawii LN, Pertin M. Profile of traumatic spinal cord injury patients admitted in physical medicine and rehabilitation department of a tertiary care hospital: A North-East India Experience. *Int J Pharm Med Res* 2013;24:40-3.
3. Gosselin RA, Coppotelli C. A follow-up study of patients with spinal cord injury in Sierra Leone. *Int Orthop* 2005;29:330-2.
4. Ahuja CS, Wilson JR, Nori S, Kotter MR, Druschel C, Curt A, *et al.* Traumatic spinal cord injury. *Nat Rev Dis Primers* 2017;3:17018.
5. Kawu AA. Pattern and presentation of spine trauma in Gwagwalada-Abuja, Nigeria. *Niger J Clin Pract* 2012;15:38-41.
6. Kinyanjui JW, Mulimba JA, Ombachi RB. Pattern and outcome of spinal injury at Kenyatta National Hospital. *East Afr Orthop J* 2016;10:1-6.
7. Furlan JC, Sakakibara BM, Miller WC, Krassioukov AV. Global incidence and prevalence of traumatic spinal cord injury. *Can J Neurol Sci* 2013;40:456-64.
8. Umaru H, Ahidjo A. Pattern of spinal cord injury in Maiduguri, North Eastern Nigeria. *Niger J Med* 2005;14:276-8.
9. Pickett GE, Campos-Benitez M, Keller JL, Duggal N. Epidemiology of traumatic spinal cord injury in Canada. *Spine (Phila Pa 1976)* 2006;31:799-805.
10. Yongu WT, Elachi CI, Mue DD, Kortor JA. Pattern of traumatic spinal cord injury in Makurdi, Nigeria. *Niger J Surg Res* 2016;17:53.
11. Witiw CD, Fehlings MG. Acute spinal cord Injury. *J Spin Disord Tech* 2015;28:202-10.
12. Liu JM, Long XH, Zhou Y, Peng HW, Liu ZL, Huang SH. Is urgent decompression superior to delayed surgery for traumatic spinal cord injury? A meta-analysis. *World Neurosurg* 2016;87:124-31.
13. Obalum DC, Giwa SO, Adekoya-Cole TO, Enweluzo GO. Profile of spinal injuries in Lagos, Nigeria. *Spinal Cord* 2009;47:134-7.
14. Jung SH. Stratified Fisher's exact test and its sample size calculation. *Biom J* 2014;56:129-40.
15. Akinpelu AO, Maduagwu SM, Odole AC, Alonge TO. Prevalence and pattern of knee osteoarthritis in a northeastern Nigerian rural community. *East Afr Orthop J* 2011;5:5-11.
16. Ibikunle PO, Okoro EO. A fifteen years retrospective study of spinal cord injury in South-Eastern Nigeria. *EC Orthop* 2018;9:671-87.
17. Kumar D, Srivastava MK, Gupta AK, Mishra S, Yadav G. Pattern of traumatic spinal cord injury in a tertiary rehabilitation centre of Northern India. *Indian J Phys Med Rehabil* 2018;29:72-6.
18. Zeinali A, Mellat A, Rahimdel A, Alahsab A. A study on demographic pattern, causes and level of lesion in the spinal cord injured patients in

- Yazd City in 2009-2015. *Int J Med Res Health Sci* 2016;5:447-51.
19. Kawu AA, Alimi FM, Gbadegesin AA, Salami AO, Olawepo A, Adebule TG, *et al.* Complications and causes of death in spinal cord injury patients in Nigeria. *West Afr J Med* 2011;30:301-4.
 20. Swain L, Rautray PN, Singh M. Epidemiology of distribution and patterns of blunt traumatic cervical spine injury: A retrospective cross-sectional observational study. *Int J Contemp Med Res* 2018;5:L1-7.
 21. Kamrunnaher K, Helal SU, Saha PC, Taoheed F, Arafat SM, Rahman MA, *et al.* Neurological recovery and functional outcome of complete traumatic spinal cord injury patients: An observation from Bangladesh. *Int J Physiother Res* 2018;6:2648-53.
 22. Pandey V, Nigam V, Goyal TD, Chhabra H. Care of post-traumatic spinal cord injury patients in India: An analysis. *Indian J Orthop* 2007;41:295-9.
 23. Cawley MF, Yarkony GM, Bergman SB. Spinal cord injury rehabilitation. 5. Through the lifespan. *Arch Phys Med Rehabil* 1997;78:S73-8.
 24. Westgren N, Levi R. Quality of life and traumatic spinal cord injury. *Arch Phys Med Rehabil* 1998;79:1433-9.