Is carpal tunnel release under-utilized in veterans with spinal cord injury?

Cameron Barr¹, Paola Suarez², Doug Ota^{1,3}, Catherine M. Curtin^{4,5}

¹Department of Orthopedic Surgery, Stanford University School of Medicine, Stanford, CA, USA, ²Center for Health Care Evaluation, Department of Veterans Affairs (VA) Palo Alto Health Care System, Menlo Park, CA, USA,

³Spinal Cord Injury Service, Department of Veterans Affairs (VA) Palo Alto Health Care System, Palo Alto, CA, USA,

⁴Rehabilitation and Research and Development, Department of Veterans Affairs (VA) Palo Alto Health Care System, Palo Alto, CA, USA, ⁵Division of Plastic Surgery, Stanford University, Stanford, CA, USA

Objective: Carpal tunnel syndrome (CTS) is a common disorder among individuals with spinal cord injury (SCI). Although carpal tunnel release is highly effective, the procedure may be under-utilized in this population. This study attempts to identify if CTS is under-treated in Veterans with SCI.

Design: The Veterans Affairs (VA) National Patient Care Database was used for data compilation within fiscal years 2007 and 2008. Using ICD-9-CM diagnoses codes, individuals with SCIs were identified, including those diagnosed with CTS. Current procedural terminology (CPT) codes further showed those who had undergone surgical intervention including open and endoscopic release of the transverse carpal ligament. The VA SCI cohort was compared to the general VA population with regard to demographics, diagnosis, surgical intervention, and treatment location.

Results: A total of 19 296 veterans with SCI were identified within the 2-year period. The prevalence of CTS within this cohort was 3.5%, compared to 2.1% in the general VA population. The rate of transverse carpal ligament release was similar between the VA SCI cohort and general population (0.24 and 0.17%, respectively). The majority of surgical treatment (89%) occurred within the VA 'hub-and-spoke' system of SCI care.

Conclusion: CTS appears to be under-diagnosed and under-treated in veterans with SCI.

Keywords: Spinal cord injuries, Tetraplegia, Paraplegia, Carpal tunnel syndrome, Veterans, Hand surgery, Utilization

Introduction

Carpal tunnel syndrome (CTS) is among the most common disorders of the upper extremity. With an incidence of 1–3 cases per 1000 subjects per year in the United States, it is the most frequent upper-extremity compressive neuropathy.¹ The optimal treatment of CTS has been thoroughly investigated. Both non-surgical and surgical treatment have been found to be effective in the short term; however, superior long-term outcomes have been associated with surgical release of the transverse carpal ligament.^{2–5} Carpal tunnel release (CTR) surgery is the most common hand surgery in the United States, with approximately 577 000 procedures performed each year.⁶

Although CTS is a common condition within the general population, it is even more so among people with spinal cord injury (SCI). In comparison with a prevalence of approximately 5% in the general

population,¹ studies indicate that 16–78% of individuals with SCI have CTS.^{7–10}

It is well known that patients with SCI suffer upper-extremity pain. Sie *et al.*¹¹ found 55% of patients with tetraplegia and 64% of patients with paraplegia to report upper-extremity pain. Complaints related to CTS were the most common, followed by those related to shoulder pain. Similar trends were found by Gellman *et al.*,¹² who also showed that symptoms increased with time from injury.

It is thought that the increased prevalence of CTS within this population is related to the fact that the patients rely on their upper extremities for weight-bearing activities such as transfers and wheelchair propulsion. Previous studies have demonstrated that median nerve conduction velocity can be negatively affected by wheelchair stroke propulsion biomechanics and wheelchair weight.^{13,14} Furthermore it has been shown that patients with SCI who have CTS consistently have higher carpal canal pressures with both dynamic tasks and static wrist positions.¹⁵

Correspondence to: Catherine M. Curtin, Rehabilitation and Research and Development, Spinal Cord Injury Service, Department of Veterans Affairs Palo Alto Health Care System, 3801 Miranda Avenue (MC-128), Palo Alto, CA 94304, USA. Email: curtincatherine@yahoo.com

It is estimated that roughly 300 000 people in the United States are living with SCI.¹⁶ Nearly 50 000 of these individuals are veterans, making the Department of Veterans Affairs (VA) the largest provider of specialty SCI care in the United States.¹⁷ Individuals with SCI are living longer and providers, including those within the VA, are focusing their efforts beyond life-saving treatments to those that improve quality of life. CTS is a disease process that frequently impacts quality of life for people with SCI. This study used administrative data collected from veterans with SCI, one of the largest cohorts of patients with SCI in the world, to assess patterns of diagnosis and treatment of CTS. We hypothesized that as a common but often less pressing presenting problem, CTS may be currently under-diagnosed and under-treated in the VA population with SCI.

Methods

Data

The VA National Patient Care Database (NPCD) was used for data compilation. The NPCD contains clinical data related to outpatient and inpatient care, including demographics, visit date, diagnoses, and procedures performed. Data from 2007 and 2008 fiscal years were evaluated.

Although there are other data sources for identifying veterans with SCI (i.e. Allocation Resource Center, National Spinal Cord Dysfunction Registry), they have inherent limitations of being self-populated and voluntarily maintained.¹⁸ We initially planned to include the registry but found a large number of missing values in our variables of interest. The NPCD includes demographics and utilization data for all VA facilities that is updated nightly with patient medical record information from local VA facilities.

Cohort

Individuals with SCI were identified using the International Classification of Diseases, 9th Revision; Clinical Modification (ICD-9-CM) diagnoses codes (344.0x, 344.1, 806x, 907.2, 952.x). Excluded were those people with neurological diagnoses, such as multiple sclerosis, that could result in paralysis (335.24, 335.2, 340, 341.x). We included only people who had an SCI diagnosis recorded in at least one face-to-face clinician visit (i.e. not a telephone, lab, or pharmacy encounter). A sensitivity analysis showed that by increasing the requirement to at least two documented SCI encounters there would be a loss of less than 5% of the patients, and thus we did not impose stricter inclusion criteria. Our comparison group represented VA veteran patients who had any face-to-face clinician visit.

Variables

We identified age, gender, race, marital status, and population type (outpatient or inpatient) for the SCI cohort. Using ICD-9-CM diagnoses codes and current procedural terminology (CPT) procedure codes, we further elicited those diagnosed with CTS (ICD-9-CM 354.0) and those who have undergone surgical intervention including open and endoscopic release of the transverse carpal ligament (CPT: 64721, 29848; ICD-9-CM surgery code: 04.43). Injection of the carpal tunnel used the CPT code 2052. Level of injury (paraplegia/tetraplegia/unspecified) was based on the most frequent diagnosis (ICD9-CM code). For patients with equal recordings of two diagnoses, we chose the most recent diagnosis. We also were interested in assessing place of care. The VA offers specialized SCI care within a 'hub-and-spoke' system.¹⁹ This system consists of centers with a multi-disciplinary SCI team (i.e. hubs) and satellite locations with more SCI primary care (i.e. spokes). Within this system, there are 24 regional hubs and 150 spokes.¹⁷ The patient's hub or spoke was assigned by determining the most frequent VA facility visited during the 2-year period.

Analysis

We first analyzed the outpatient files for patients with CTS and/or surgeries. We then did the same for the inpatient files for patients that did not have an outpatient carpal tunnel diagnosis or surgery. To ensure the capture of all patients meeting inclusion criteria, we also checked the fee basis files for the carpal tunnel procedure codes. The fee basis accounts for care provided by the VA through outside medical providers. Fee basis is offered when care is unavailable at the local VA. We calculated basic counts and percentages of the SCI and general VA populations.

Results

The database search identified a VA population of 5 862 471 patients within the chosen time frame. Those fitting the SCI inclusion criteria totaled 19 296. In the VA SCI cohort, a diagnosis of 'paraplegia' was made in over half (56%) of the patients, with 'tetraplegia' making up 30% and the remaining being 'unspecified.' The majority of the individuals with SCI were identified through outpatient rather than inpatient encounters (92 versus 8%). We then looked at the demographics of those who received a diagnosis of CTS, comparing the VA SCI cohort to the VA general population. We found 123 314 veterans in the general population and 668 in the VA SCI cohort with a diagnosis of CTS, which represents a prevalence of 2.1 and 3.5% in

these populations, respectively. Further analysis of the VA SCI cohort identified 4.0% of the patients with paraplegia (420/10 420) and 2.4% of the patients with tetraplegia (173/7332) were given the diagnosis of CTS. Table 1 presents the demographics of those in the VA general population and the VA SCI cohort who had a diagnosis of CTS. As would be expected in a veteran population, most patients were male. The mean ages of the two groups were both 60. Overall the populations were comparable, but the VA SCI group was more likely to be divorced and white. We next wanted to identify those who underwent an intervention for CTS. We looked at both injection as well as surgical procedures and compared the VA population and the VA SCI cohort. Carpal tunnel injection was not a frequently coded procedure with 1372 (0.02%) of the VA general population and 11 (0.06%) of the VA SCI population having these codes (0.06% paraplegia, 0.05% tetraplegia). Surgery was more frequent with 10 066 (0.17%) of all veterans and 47 (0.24%) of the VA SCI group having CTRs in the 2 years. Similar rates of surgery were found between patients with paraplegia and tetraplegia (0.22 and 0.23%, respectively). Table 2 shows the characteristics of those who received CTS interventions. Carpal tunnel surgery could be either endoscopic

or open. Open release was used predominately in both the SCI cohort and general population (85 and 92%, respectively, Table 3). Finally, we wanted to know more about those patients with SCI who did receive CTR. We found that 49% had paraplegia and 36% had tetraplegia, similar to the general VA population (Table 2). The majority of their surgical treatment (89%) occurred within the VA 'hub-and-spoke' system of SCI care. Surgeries were performed at a hub in 40% of cases and at a spoke in 49% of cases (Table 4). The remainder of cases occurred at VA facilities outside the 'hub-and-spoke' system. Of the 30 sites where CTR was performed on patients with SCI, 15 performed only one CTR in the 2-year period. The site with the most CTR performed on patients with SCI accounted for six total procedures.

Discussion

This study evaluated the prevalence of CTS diagnosis and surgical treatment in a national cohort of patients with SCI. It is known that CTS is an extremely common sequela of long-term upper-extremity weight bearing and wheelchair use.^{7,13,14} In a cross-sectional multicenter study, Yang⁹ found that 60% of subjects with SCI had physical examination findings consistent with CTS and 78% had electrophysical evidence of median mononeuropathy. Within our cohort of veterans with SCI, the prevalence of a diagnosis of CTS in the administrative data was 3.5%, which is significantly lower than the reported rates in other patient studies.

Many factors could contribute to this low rate of diagnosis. The first has to do with the data itself. Quality of data entry limits any administrative data, with miscoding and under-coding compromising the final results.^{20,21} Under-coding is magnified in complex patients with multiple medical problems. For example during an SCI primary care visit a provider may review multiple medical issues and code the visit with a general code such as 'late effects of spinal cord injury' (ICD-9-CM 907.2). Even if the provider discusses CTS, no related diagnosis code exists in the record. Similarly, when addressed during an inpatient hospitalization, CTS often fails to generate a diagnosis code. With a specific visit for CTS such as a consult to a hand surgeon or electro-diagnostics, the encounter generates the specific code for CTS. Even accounting for under-coding, it would be reasonable to expect that since prevalence of CTS is higher in people with SCI our VA SCI cohort would have a substantially higher rate of diagnosis than the general VA population, and not the 1% difference we found. Rates of CTS surgery were similar for VA patients with and without

Table 1 Demographics of Veterans with CTS diagnosis in FY 2007–2008

N	General VA 123 314	VA SCI 668
Sociodemographics		
Gender, % (N)		
Male	89.4 (110 194)	94.3 (630)
Age, % (N)		
18–24	0.3 (371)	0.0 (0)
25–34	3.7 (4576)	1.7 (11)
35–44	8.0 (9868)	7.0 (47)
45–54	19.7 (24 326)	19.6 (131)
55–64	37.1 (45 699)	41.2 (275)
65–74	15.0 (18 474)	17.1 (114)
75 +	16.2 (20 000)	13.4 (90)
Marital status, % (N)		
Married	56.3 (69 419)	51.7 (345)
Divorced	24.9 (30 724)	27.0 (180)
Never/single	12.7 (15 673)	13.6 (91)
Widowed	5.4 (6609)	6.6 (44)
Unknown	0.7 (889)	1.2 (8)
Race, % (N)		
White	64.3 (79 285)	71.4 (477)
Black	15.9 (19 589)	13.5 (90)
Other	2.6 (3206)	2.6 (17)
Unknown	17.2 (21 234)	12.6 (84)
Place of diagnosis, % (N)		
Outpatient	99.2 (122 294)	92.2 (616)
Inpatient	0.8 (1020)	7.8 (52)
SCI category, % (N)		
Paraplegia	N/A	62.9 (420)
Tetraplegia	N/A	25.9 (173)
Unspecified	N/A	11.2 (75)

Table 2 Demographics of Veterans who received treatment for CTS in FY 2007–2008

N	Carpal tunnel release ^a		Carpal tunnel injections	
	General VA 10 066	VA SCI 47	General VA 1372	VA SCI 11
Sociodemographics				
Gender, % (N)				
Male	91.2 (9175)	93.6 (44)	88.3 (1211)	81.8 (9)
Age, % (N)				
18–24	0.1 (7)	0.0 (0)	0.0 (0)	0.0 (0)
25–34	1.8 (179)	0.0 (0)	3.5 (48)	0.0 (0)
35–44	6.2 (621)	6.4 (3)	8.5 (117)	18.2 (2)
45–54	18.0 (1815)	14.9 (7)	20.6 (282)	27.3 (3)
55–64	38.1 (3837)	44.7 (21)	35.5 (487)	27.3 (3)
65–74	17.3 (1745)	23.4 (11)	13.1 (180)	27.3 (3)
75+	18.5 (1862)	10.6 (5)	18.8 (258)	0.0 (0)
Marital status, % (N)				
Married	57.0 (5736)	57.5 (27)	60.7 (833)	45.5 (5)
Divorced	26.2 (2640)	29.8 (14)	22.7 (311)	36.4 (4)
Never/single	10.2 (1028)	8.5 (4)	10.1 (139)	18.2 (2)
Widowed	6.3 (630)	4.3 (2)	6.0 (82)	0.0 (0)
Unknown	0.3 (32)	0.0 (0)	0.5 (7)	0.0 (0)
Race, % (N)				
White	73.2 (7371)	63.8 (30)	65.2 (895)	63.6 (7)
Black	10.2 (1025)	21.3 (10)	11.7 (161)	27.3 (3)
Other	2.5 (253)	0.0 (0)	2.4 (33)	9.1 (1)
Unknown	14.1 (1417)	14.9 (7)	20.6 (283)	0.0 (0)
Place of surgery, % (N)				
Outpatient	99.8 (10 043)	95.7 (45)	99.9 (1370)	100.0 (11)
Inpatient	0.2 (23)	4.3 (2)	0.1 (2)	0.0 (0)
SCI category, % (N)				
Paraplegia	N/A	48.9 (23)	N/A	54.6 (6)
Tetraplegia	N/A	36.2 (17)	N/A	36.4 (4)
Unspecified	N/A	14.9 (7)	N/A	9.1 (1)

Table 3 Specific carpal tunnel surgery performed on Veterans in FY 2007–2008

N	General VA 10 066	VA SCI 47
Surgery type, % (N)		
Endoscopic carpal tunnel release	7 (730)	13 (6)
Open carpal tunnel release	92 (9280)	85 (40)
Endoscopic and open release	1 (56)	2 (1)

Table 4 Facility type for carpal tunnel diagnosis and treatment in the SCI cohort in FY 2007–2008

	Primary facility type		
	Hub, % (N)	Spoke, % (N)	Neither, % (N)
Site of diagnosis	44 (295)	45 (299)	11 (74)
Site of surgery	40 (19)	49 (23)	11 (5)

SCI (0.24 and 0.17%, respectively). Surgical treatment is much less likely to suffer from the problem of under-coding because a code must be entered for every surgical procedure. Given the reported higher incidence of CTS in the population with SCI we would again expect a higher rate of surgery in this population. These two

results suggest that CTS is being under-diagnosed and possibly under-treated in patients with SCI. What could be the reasons for these seemingly lower than expected rates of diagnosis and surgical treatment? Identifying provider, system, and patient-level factors may help to gain understanding. Providers of SCI care are key players in the diagnosis and treatment of a variety of conditions. One constant for SCI providers is the issue of competing demands. Competing demands refers to prioritizing medical needs in complex patients. This can inherently result in decreased recognition or treatment of all health care issues. Redelmeier *et al.*²² demonstrated this in his study of Canadian primary care, which found an inverse correlation with the presence of a chronic disease and the treatment of unrelated health problems. In the SCI population, this may mean that ‘lesser’ issues such as CTS are not addressed during a typical visit.

Another provider factor could be caution in referring patients with SCI for invasive procedures. This could stem from comfort and experience in treating CTS non-operatively, following patient desires for conservative treatment, or uncertainty towards the efficacy of surgical interventions. The Consortium of Spinal Cord

Medicine has published practice guidelines for upper extremity care in patients with SCI.²³ It recommends that a medical or rehabilitative approach be considered first for non-traumatic limb injuries and only when conservative measures have failed to show improvement for 3 months should surgery then be considered. The guidelines go on to note the strain and mobility limitations that the recovery period may have on wheelchair-bound individuals. Although conservative treatment is supported in patients with SCI, especially in early CTS, additional literature shows that the most effective long-term treatment for CTS is surgical and risks are quite small.^{2-5,24-26} A recent meta-analysis of four randomized controlled trials concluded that surgical release of the transverse carpal ligament relieves symptoms significantly better than splinting and that a significant proportion of people treated medically will ultimately require surgery.² Such literature suggests that even if care of CTS followed the conservative course outlined by the Consortium of Spinal Cord Medicine, there would still be many people with SCI who would require surgical release.

The 'system-level' factors associated with SCI care refer to aspects of health care structure and delivery methods influencing patient outcome. In the VA population, insurance status is not a barrier to care. Regarding access to specialists, the majority of patients with SCI within the VA system are cared for by teams with a dedicated focus on SCIs. Close to 90% of the CTS treatment for our VA SCI cohort came from within the 'hub-and-spoke' system. These providers manage the patient with SCI as a whole, and understand the specific concerns facing such patients. Access to a referral network is built into the system. Within this system of dedicated SCI care, there was an evenly distributed low rate of CTS intervention among the locations. This very well may stem from experienced SCI teams being confident and successful in treating patients with conservative measures or hand surgeons' general unwillingness to participate in SCI care. The VA has an integrated system of care and we can only hypothesize that rates would be lower in a community setting with increased systemic and monetary barriers to care.

Patient factors related to care utilization are more difficult to extrapolate from this study. Overall, demographics were similar between the VA patients with SCI and the general VA population. When comparing veterans with paraplegia to those with tetraplegia, those with paraplegia were only slightly more likely to have a diagnosis of CTS. We expected that this difference would be greater and people with tetraplegia

would have much lower rates of CTS given that some would not have the strength to propel a wheelchair, bear weight, or have functional median nerves. Numerous studies have evaluated CTS in individuals with SCI below T1. However, studies on CTS in people with tetraplegia and assessing interaction of CTS with mobility status are lacking. Additional studies, between individuals with paraplegia versus tetraplegia, identifying differences in wrist position with wheelchair propulsion may elucidate this lack of significant difference.

It is known that upper-extremity function is critical to people with SCI. Such individuals rank the function of the upper limb as their most important residual function, more so than bowel, bladder, or sexual function.²⁷ Although patients with SCI may want definitive treatment for their upper-extremity pain, they may also be hesitant to lose their sole source of mobility for several weeks or risk a more permanent surgical complication. Subjective measures, however, were not a part of our study. Future research should focus on potential patient perceptions of CTR.

An inherent limitation of this study lies in the data source utilized (NPCD). As Smith *et al.*¹⁸ identified, only 32.6% of SCI veterans were included in all three of the VA SCI data groups evaluated (ARC, SCD Registry, NPCD flag). The data source for this study surely did not capture all veterans with SCI. Although limited, the VA data still provide insights into care of a large cohort of patients with SCI.

Conclusion

This study showed lower-than-expected rates of diagnosis and surgical intervention for CTS in a large cohort of people with SCI. The next steps will be to better understand potential barriers to diagnosis and treatment so that strategies can be implemented to improve patient care.

Acknowledgement

Dr Curtin is supported by the VHA RR&D Career Development Award.

Disclaimer

The views expressed in this article are those of the authors and do not necessarily represent the views of the Department of Veterans Affairs.

References

- 1 Clinical Practice Guidelines on the Treatment of Carpal Tunnel Syndrome 2008. Available from: <http://www.aaos.org/Research/guidelines/ctstreatmentguideline.pdf>
- 2 Verdugo RJ, Salinas RA, Castillo JL, Cea JG. Surgical versus non-surgical treatment for carpal tunnel syndrome. Cochrane Database Syst Rev 2008;CD001552.

- 3 Gonzalez MH, Bylak J. Steroid injection and splinting in the treatment of carpal tunnel syndrome. *Orthopedics* 2001;24(5):479–81.
- 4 Graham RG, Hudson DA, Solomons M, Singer M. A prospective study to assess the outcome of steroid injections and wrist splinting for the treatment of carpal tunnel syndrome. *Plast Reconstr Surg* 2004;113(2):550–6.
- 5 Gelberman RH, Aronson D, Weisman MH. Carpal-tunnel syndrome. Results of a prospective trial of steroid injection and splinting. *J Bone Joint Surg Am* 1980;62(7):1181–4.
- 6 Cullen KA, Hall MJ, Golosinskiy A. Ambulatory surgery in the United States, 2006. *Natl Health Stat Report* 2009;(11):1–25.
- 7 Gellman H, Chandler DR, Petrusek J, Sie I, Adkins R, Waters RL. Carpal tunnel syndrome in paraplegic patients. *J Bone Joint Surg Am* 1988;70(4):517–19.
- 8 Aljure J, Eltorai I, Bradley WE, Lin JE, Johnson B. Carpal tunnel syndrome in paraplegic patients. *Paraplegia* 1985;23(3):182–6.
- 9 Yang J, Boninger ML, Leath JD, Fitzgerald SG, Dyson-Hudson TA, Chang MW. Carpal tunnel syndrome in manual wheelchair users with spinal cord injury: a cross-sectional multicenter study. *Am J Phys Med Rehabil* 2009;88(12):1007–16.
- 10 Nemchausky BA, Ubelluz RM. Upper extremity neuropathies in patients with spinal cord injuries. *J Spinal Cord Med* 1995;18(2):95–7.
- 11 Sie IH, Waters RL, Adkins RH, Gellman H. Upper extremity pain in the postrehabilitation spinal cord injured patient. *Arch Phys Med Rehabil* 1992;73(1):44–8.
- 12 Gellman H, Sie I, Waters RL. Late complications of the weight-bearing upper extremity in the paraplegic patient. *Clin Orthop Relat Res* 1988;(233):132–5.
- 13 Boninger ML, Cooper RA, Baldwin MA, Shimada SD, Koontz A. Wheelchair pushrim kinetics: body weight and median nerve function. *Arch Phys Med Rehabil* 1999;80(8):910–15.
- 14 Boninger ML, Impink BG, Cooper RA, Koontz AM. Relation between median and ulnar nerve function and wrist kinematics during wheelchair propulsion. *Arch Phys Med Rehabil* 2004;85(7):1141–5.
- 15 Goodman CM, Steadman AK, Meade RA, Bodenheimer C, Thornby J, Netscher DT. Comparison of carpal canal pressure in paraplegic and nonparaplegic subjects: clinical implications. *Plast Reconstr Surg* 2001;107(6):1464–71; discussion 72.
- 16 National Spinal Cord Injury Statistical Center. Spinal Cord Injury Facts and Figures at a Glance 2010 [accessed 2011 Jan 20]. Available from: http://www.nscisc.uab.edu/public_content/pdf/Facts%20and%20Figures%20at%20a%20Glance%202010.pdf.
- 17 Department of Veterans Affairs; Spinal Cord Injury and Disorders. Spinal Cord Injury Fact Sheet 2009 [accessed 2011 Jan 20]. Available from: <http://www.sci.va.gov>.
- 18 Smith BM, Evans CT, Ullrich P, Burns S, Guihan M, Miskevics S, et al. Using VA data for research in persons with spinal cord injuries and disorders: lessons from SCI QUERI. *J Rehabil Res Dev* 2010;47:679–88.
- 19 Department of Veterans Affairs, Office of Public Affairs, Media Relations. VA and Spinal Cord Injury Fact Sheet 2009 [accessed 2011 Jan 20]. Available from: http://www1.va.gov/opa/publications/factsheets/fs_spinal_injury.pdf.
- 20 King MS, Lipsky MS, Sharp L. Expert agreement in current procedural terminology evaluation and management coding. *Arch Intern Med* 2002;162(3):316–20.
- 21 Holt J, Warsy A, Wright P. Medical decision making: guide to improved CPT coding. *South Med J* 2010;103(4):316–22.
- 22 Redelmeier DA, Tan SH, Booth GL. The treatment of unrelated disorders in patients with chronic medical diseases. *N Engl J Med* 1998;338(21):1516–20.
- 23 Boninger ML, Waters RL, Chase T, Dijkers MPJM, Gellman H, Girona RJ. Preservation of upper limb function following spinal cord injury: a clinical practice guideline for health-care professionals. *J Spinal Cord Med* 2005;28(5):434–70.
- 24 Bande S, De Smet L, Fabry G. The results of carpal tunnel release: open versus endoscopic technique. *J Hand Surg Br* 1994;19(1):14–17.
- 25 Botte MJ, von Schroeder HP, Abrams RA, Gellman H. Recurrent carpal tunnel syndrome. *Hand Clin* 1996;12(4):731–43.
- 26 Murphy RX Jr., Jennings JF, Wukich DK. Major neurovascular complications of endoscopic carpal tunnel release. *J Hand Surg Am* 1994;19(1):114–18.
- 27 Hanson RW. The psycho-ecological approach to spinal cord injury rehabilitation: a behaviorist perspective. *Rehabil Psychol* 1974;21(1):39–43.