JRRD Volume 44, Number 5, 2007
Pages 703–716
Journal of Rehabilitation Research & Development

Chronic pain after spinal cord injury: What characteristics make some pains more disturbing than others?

Elizabeth Roy Felix, PhD;[1–2]* Yenisel Cruz-Almeida, MSPH;[1–3] Eva G. Widerström-Noga, DDS, PhD[1–4]
[1]Research Service, Department of Veterans Affairs Medical Center, Miami, FL; [2]The Miami Project to Cure Paralysis, [3]Neuroscience Program, and [4]Department of Neurological Surgery, University of Miami Miller School of Medicine, Miami, FL

Abstract—Different types of pain are often present in the same individual with spinal cord injury (SCI). Relieving the most disturbing of these pains may substantially affect quality of life. Persons with SCI and chronic pain (n = 194) completed a structured interview that detailed the characteristics of each pain they experienced. Pairwise analyses revealed that the following characteristics were more common among the most disturbing pains: "sharp"; "stabbing"; located at the level of injury; frequently aggravated; and having high intensity, unpleasantness, constancy, interference, and neuropathic pain-like features. A conditional logistic regression analysis showed that the combination of "sharp" and high pain intensity, interference, aggravation, and constancy significantly predicted the most disturbing pain ($p < 0.001$). This study suggests that, in addition to pain intensity, factors such as interference, quality, aggravation, and constancy of pain are important to consider when one evaluates SCI-related pain, since these symptoms may indicate pains that are particularly disturbing to an individual with SCI.

Key words: chronic pain, intractable pain, neuropathic pain, numerical rating scale, pain descriptors, pain interference, quality of life, rehabilitation, spinal cord injury, structured interview.

INTRODUCTION

Chronic pain is one of the most common secondary complications of spinal cord injury (SCI), with most reports estimating that more than 60 percent of individuals with SCI have chronic pain [1–9]. The presence of chronic pain has been reported to decrease quality of life after SCI [2,10–12] and to frequently interfere with both sleep and common daily activities [2,5–6,8,13]. Chronic pain in individuals with SCI is particularly problematic because several types of pain may exist simultaneously [2,6–9,14–15], and many of these pains are refractory to currently available treatments [8,16–21]. Because pain in this patient population is heterogeneous and persons with SCI often present with more than one type of pain, each pain should be evaluated separately to the extent possible.

Recent taxonomies for SCI-related chronic pain classify pains as either neuropathic or nociceptive and according to their location relative to the level of injury (LOI) [22–23]. These pains may be caused by different mechanisms at the spinal cord, thalamic, and cortical levels [24]. Because SCI-related pain is persistent, examining not only the underlying mechanisms of pain but also which aspects of the pain problem the individual patient considers most disturbing (MD) are important. In addition

Abbreviations: ASIA = American Spinal Injury Association, LD = less disturbing, LOI = level of injury, MD = most disturbing, NRS = numerical rating scale, OR = odds ratio, SCI = spinal cord injury, VA = Department of Veterans Affairs.

***Address all correspondence to Elizabeth R. Felix, PhD, Research Assistant Professor; Department of Rehabilitation Medicine, University of Miami Miller School of Medicine, PO Box 016960, C-206, Miami, FL 33101; 305-243-4497. Email: efelix@med.miami.edu**
DOI: 10.1682/JRRD.2006.12.0162

to a mechanisms-based treatment strategy, efforts concentrated on reducing the MD aspects of pain may reduce patient suffering and improve overall well-being. Although many studies have examined the characteristics of SCI-related pain and its overall impact on quality of life, to our knowledge no reports have focused specifically on which characteristics make one pain more disturbing than another in an individual with SCI.

Studies in other pain-patient populations have defined disturbing pain as "constant (or occurring several times a day) and interfering with daily life to a degree described by the patients as moderate or severe" [25] and as "severe" and "evidenced by interference in lifestyle" [26]. Reports from the SCI literature also point to particular aspects of a pain that may make it especially problematic or disturbing to persons with SCI and chronic pain. One such aspect is pain intensity or severity. Higher pain intensity ratings have been significantly correlated with increased difficulty in dealing with pain in the SCI population [27]. Similarly, a nearly significant difference (p = 0.07) in pain intensity scores was found for pains identified as worst compared with those identified as second worst by 124 persons with SCI who experienced more than one pain [15]. In the same study, worst pains were more likely to be classified as neuropathic [15]. Likewise, neuropathic pain has been associated with higher intensity levels than musculoskeletal pains in individuals with SCI [28].

Neuropathic pains usually present with allodynia (pain felt in response to a normally innocuous stimulus) and/or hyperalgesia (increased sensation of suprathreshold nociceptive stimuli) [29–31], which are most often found "at" the LOI (a five-dermatome region encompassing the neurologically determined LOI [22]). Nonpainful sensations, such as dysesthesias (unpleasant abnormal sensations), may also be associated with the SCI and 30.2 percent of those who experience these nonpainful sensations have reported them to be very difficult to deal with (rated as ≥7 on a 10-point numerical rating scale [NRS]) [7].

If specific characteristics of pain are perceived as particularly disturbing, examining the underlying mechanisms associated with these characteristics may be useful. In fact, basic research suggests that various pathophysiological mechanisms, either alone or combined, may underlie specific sensory signs and symptoms such as burning pain, heat hyperalgesia, or mechanical hyperalgesia [32–33]. Because SCI-related pains are refractory and heterogeneous, an interdisciplinary treatment approach that incorporates strategies for reducing the symptoms and distress associated with chronic pain (e.g., specific characteristics of pain and its emotional and physical impact) may be effective combined with treatment strategies focused on eliminating the underlying pathophysiological mechanisms of the pain [34].

The current study determined which specific pain characteristics were most strongly associated with pains described as being MD by an individual with SCI. Considering the previous reports in the literature [15,25–31], we hypothesized that high-intensity pains that significantly interfered with daily life and were located at-level with neuropathic pain-like qualities would be the MD pains for those with SCI and chronic pain. The identification of the characteristics of pain that define its disturbing nature may be useful in the design of multidisciplinary treatment approaches that aim to reduce the overall impact of chronic pain on quality of life.

METHODS

Participants

Individuals 18 years or older with traumatic SCI and chronic pain of more than 6 months duration were recruited from the Miami community to participate in this study. Recruitment was conducted by advertisements posted around the Miami Department of Veterans Affairs (VA) Medical Center and the University of Miami/Jackson Memorial Hospitals and Clinics, including The Miami Project to Cure Paralysis, and by word of mouth. The institutional review boards of the Miami VA Medical Center and the University of Miami approved the study.

Participants (n = 195) with SCI-related chronic pain who were at least 2 years postinjury underwent extensive structured interviews regarding their pain. Because many people with cervical injuries are physically unable to complete a large set of questionnaires, we conducted assessments for all participants by interview to ensure consistent data collection and reduce participant burden. The interview consisted of a pain history questionnaire, questions regarding medical and demographic factors, and a battery of well-established psychometric instruments. Only data from the pain history and the medical and demographic questionnaires were analyzed for the present article. A previous article reported results from other aspects of the larger study [35]. The interviewers (including authors ERF and YC-A) were trained during multiple sessions before independently carrying out the interviews. Participants were paid $50 for their time.

Demographic and Injury Characteristics

The participants' age, sex, cause of injury, recent medical history, living situation, and racial/ethnic background were recorded as part of the structured interview. A neurologist with extensive SCI experience, or a second physician who was training in SCI rehabilitation medicine, physically examined each participant to assess neurological status and to determine the severity of the SCI. The assessment of SCI was based on American Spinal Injury Association (ASIA) standards [36–37]. For this analysis, if the LOI was different for the left and right sides and/or for the motor and sensory examinations, the overall LOI was taken as the most rostral level determined by ASIA examination.

Pain History

After giving informed consent, participants were interviewed in a quiet, private room. We took detailed pain histories using an interview-format questionnaire for pain in SCI [13,27,38]. We began the interview by asking the participants to indicate the areas where they currently experienced chronic pain (>6-months duration). Once the pain locations were defined, the participants were asked whether the pains located in different areas were distinguishable. When participants experienced two or more different pains, they were asked to answer each of the remaining questions separately for each of the identified pains.

Location of Pain

Participants indicated the location of their pain(s) by shading in corresponding areas on an outline of the human body (frontal and dorsal views), or if they were physically unable, by describing the locations to the interviewer, who drew in the indicated areas. For analysis, we divided the drawings into eight body sections: (1) head, (2) neck and shoulders, (3) arms and hands, (4) front torso and genital region, (5) back, (6) buttocks, (7) thighs, and (8) lower legs and feet [27]. This division into pain areas is based on a pain drawing that was originally described by Margolis et al. [39] and modified for our analysis [27]. The location of each pain was coded based on its overlap with the eight predefined body sections. If the participant's drawing of a pain included any part of a body section, the pain was coded as being located in that section.

Each pain was also classified based on its location relative to the participant's LOI as "above" (more than two dermatomes above the neurologically determined LOI), "at" (neurologically determined LOI, plus two dermatomes above and two dermatomes below this level [22]), or "below" (more than two dermatomes below the neurologically determined LOI). Pains that extended into more than one of these defined levels (e.g., pain that occurred at the LOI but also extended to areas below the LOI) were coded as such. We determined pain relative to LOI based on the locations indicated on the participant's pain diagram and the dermatomal map on the published ASIA standard neurological classification form [36–37].

Most Disturbing Pain

Participants were asked to choose the pain area(s) in which their MD pain was located. If no pain was considered more disturbing than another, or if only one pain was present, the participant's data were not included in the analyses.

For matched-pairs analyses, we used a less disturbing (LD) pain as a comparison for participants who experienced more than one pain and considered one of their pains the MD compared with the other pains. For participants who identified only two pains, the pain that was not indicated as the MD pain was defined as that participant's LD pain. For participants who had more than two pains, we chose an LD pain using a random selection procedure within SPSS, version 14.0 (SPSS Inc, Chicago, Illinois).

Verbal Descriptors

Participants chose from a list of 24 verbal descriptors that were selected based on the pain literature and previous interviews with persons with SCI and pain [40–42]. The descriptors were aching, biting, burning, cold, cramping, crushing, cutting, dull, electric, flashing, lacerating, lancinating, penetrating, pinching, pressing, pricking, pulsating, radiating, sharp, shocking, shooting, stabbing, stinging, and throbbing. Participants were allowed to choose any number of descriptors for each of their pains and to add their own descriptors as needed. The 10 most frequently chosen descriptors were examined for differences in prevalence between MD pains and LD pains. In addition, the number of descriptors chosen for each pain was summed and tested for differences between matched MD and LD pains.

Intensity and Unpleasantness of Pain

NRSs have been used widely to assess pain and have shown high reliability and validity [43]. Participants were asked to rate how intense each of their pains was on average using an 11-point NRS, with "0" indicating "no pain" and "10" indicating "the most intense pain imaginable." A separate NRS, with "0" for "no pain" and "10" for "the most unpleasant pain imaginable," was used to measure how unpleasant each pain was on average.

Pain Interference

Participants were asked five questions about how often each of their pains interfered with sleep, exercise, household chores, and other daily activities. Two questions were asked about sleep: (1) How often is it difficult to go to sleep because of pain? and (2) How often do you wake up because of pain? Participants were given five answers to choose from: (1) never, (2) one to three nights per month, (3) one or two nights per week, (4) three to six nights per week, and (5) every night. Five answer options were also given for questions about how often pain interfered with exercise habits or household chores: (1) I do not normally exercise/do household chores, (2) pain never interferes, (3) pain sometimes interferes, (4) pain often interferes, and (5) pain always interferes with my exercise/household chores. Lastly, participants were asked how often pain interferes with other daily activities and were given the following answer options: (1) never, (2) sometimes, (3) often, and (4) always.

A pain interference score was calculated for each pain based on the answers to the five pain interference questions just described. Each response category was coded by the entry of "0" for "never" and the assignment of successive integers for each level of increased interference. If a participant answered that he or she did not normally do the activity, this answer was not included in the pain interference score. We summed the scores for each type of interference to obtain an overall interference score for each pain (higher scores indicated a higher degree of pain interference).

Temporal Characteristics

Two questions were included in the interview regarding the temporal characteristics of each individual pain: (1) How often do you have pain? and (2) How often do you have breaks from this pain? For the first question, participants could choose from the following alternatives: (1) no predictable pattern, (2) 1 to 3 days per month, (3) 1 to 2 days per week, (4) 3 to 6 days per week, and (5) everyday. Possible responses for the second question were (1) no predictable pattern, (2) I have weeklong breaks, (3) I have breaks of several hours to 1 day, (4) I have breaks of several hours, (5) I have breaks of 5 minutes to 1 hour, (6) I have short breaks (<5 minutes), and (7) I have no breaks from pain. Answers were assigned a value of "0" for the lowest frequency ("1 to 3 days per month" and "I have weeklong breaks"), and successive integers were assigned for each increase in pain frequency, or constancy. We calculated a constancy of pain score by summing the values for these two questions, so that higher scores indicated more constant pain.

Factors Affecting Pain

A list of 27 factors [44–46] that might affect pain was presented to the participant, and he or she was asked, for each different pain, whether the factor "makes the pain disappear," "makes the pain considerably better," "makes the pain slightly better," "has no effect on the pain," "makes the pain worse," "makes the pain considerably worse," or whether they did not know the effect that factor had on pain. The factors listed included items referring to different activity states (lying down, getting out of bed, going outside, moving suddenly, having muscle spasms, exercising, coughing or sneezing, participating in sexual activity, prolonged sitting, changing position), different emotional states (anger, anxiety, sadness, fatigue), use of different substances (alcohol, cigarettes, caffeine, recreational drugs), climate (hot, cold, wet), and other possible aggravating or relieving factors (noise, listening to music, touch, infections, full bladder, constipation). To assess the impact of the aggravation of, or increase in, pain due to these factors, we coded each of the 27 factors for each pain as follows: a "0" was assigned to the answers "makes the pain disappear," "makes the pain considerably better," "makes the pain slightly better," and "has no effect on the pain; a "1" was assigned to the answer "makes the pain worse;" and a "2" was assigned to the answer "makes the pain considerably worse." In this way, we calculated a score for aggravation of pain, for each separate pain, by summing the degree of aggravation across all factors.

Neuropathic Pain Score

We calculated a neuropathic pain score using the verbal descriptors and aggravating factors that the International Association for the Study of Pain taxonomy lists as indicating neuropathic pain in SCI [23]. Specifically, the neuropathic pain score was calculated as the sum of the presence of the descriptors sharp, burning, shooting, stabbing, and electric, and the response of “makes the pain worse” or “makes the pain considerably worse” for the following factors: constipation, full bladder, touch, cold weather, and infections. A score ranging from 0 to 10 was calculated for each pain, with a higher score indicating that the pain had more neuropathic-like characteristics.

Statistics

We performed all statistical tests on matched-pairs data: one pain labeled as the MD was compared with another randomly selected pain (LD) for each of the 140 participants. SPSS, version 14.0, was used for the statistical analyses. For each of the subheadings in the preceding “Pain History” section, we made paired-comparisons between MD and LD pains. The McNemar test for related samples was used when chi-square tests were appropriate (body location, at-level pain location, and the use of each of the 10 most frequently chosen verbal descriptors). Because NRSs have demonstrated ordinal-scale characteristics [47], we used the sign test to examine matched-pairs differences in numerical ratings for intensity and unpleasantness between MD and LD pains. Cronbach α, a statistic that reflects the internal consistency of a scale, is reported for each of the scores calculated in the present study (pain interference, constancy of pain, aggravating factors, and neuropathic pain), but we did not evaluate other psychometric properties of these scores. Therefore, we took the conservative approach of assuming only ordinal-scale characteristics when analyzing these data: sign tests were used for all comparisons between paired MD and LD pains for which data were available. All statistical tests were two-tailed, and the Bonferroni correction was used to adjust for multiple comparisons [48]. Statistical significance was set at $\alpha = 0.05$. The number of matched pairs available for each statistical test is noted in the appropriate section within the “Results.”

We used a conditional logistic regression to examine which combination of factors would predict the classification of a pain as MD [49]. A logistic regression is a multiple regression analysis used when the dependent variable is dichotomous, and it is based on maximum likelihood estimation. A conditional logistic regression is appropriate for matched-pairs analysis, and it estimates the probability, or odds, of an event occurring. The automatic forward stepwise procedure, which was used for the present analysis, starts with no variables in the model; at each successive step, the most significant variable is determined and entered into the model. For every step, the procedure examines each variable for entry or removal until all variables in the model fulfill the criteria for retention ($\alpha = 0.10$). The odds of an event happening is the ratio of the probability of it happening to the probability of it not happening. This ratio is presented as the odds ratio (OR) value. In the conditional logistic regression of the current study, if the OR value was >1 for a particular variable, the probability of a pain being selected as MD under that particular condition was more likely than it not being selected. Conversely, if the OR value was <1, then the probability of a pain not being selected as MD (i.e., being an LD pain) under that condition was more likely than it being selected. Since no model for prediction of MD pain exists in the literature to guide variable selection, and because sample size is relatively small in comparison with the possible number of predictor variables [50], only the variables that were significantly different in the pairwise analyses were included as independent variables for prediction of the MD pain in the conditional logistic regression.

RESULTS

Of the 195 participants who completed all questionnaires, we include data from 194 of them in the results. A physician determined, based on examination, that one participant who had completed the study did not have traumatic SCI. For the matched-pairs analyses, 140 participants had more than one pain and indicated that one of their pains was the MD. Demographic and injury characteristics for these 140 participants are presented in **Table 1**.

General Characteristics of Pain in Persons with Spinal Cord Injury

When asked to identify each different chronic pain experienced, a majority of participants (80.9%) reported having more than one type of pain: 36.1 percent had two pains, 23.7 percent had three pains, and 21.1 percent had four or more separable pains (n = 194) (**Figure 1**). In total, 488 pains were reported by the 194 participants with chronic pain and SCI.

The distribution of pain locations of these 488 differentiated pains, based on participants’ drawings on a standard body map, is shown in **Figure 2**. The map was

Table 1.
Demographic and injury characteristics of participants with >1 pain (n = 140).

Characteristic	Participants
Age, yr (mean ± SD)	44.3 ± 13.4
Age at Injury, yr (mean ± SD)	37.9 ± 18.0
Time Since Injury, yr (mean ± SD)	13.2 ± 10.7
Sex, *n* (%)	
Female	18 (12.9)
Male	122 (87.1)
Level of Injury, *n* (%)	
Cervical	69 (49.3)
Below Cervical	70 (50.0)
Not Determined	1 (0.70)
Completeness of Injury, *n* (%)	
Incomplete	51 (36.4)
Complete	88 (62.9)
Not Determined	1 (0.70)
Cause of Injury, *n* (%)	
Motor Vehicle Accident	55 (39.3)
Act of Violence	35 (25.0)
Fall	19 (13.6)
Sporting Accident	14 (10.0)
Other	17 (12.1)
Racial/Ethnic Background, *n* (%)	
White Non-Hispanic	51 (36.4)
Hispanic	43 (30.7)
African American	31 (22.1)
Other	15 (10.7)
Education, *n* (%)	
Pre-High School	13 (9.3)
High School Diploma	41 (29.3)
Associate Degree/Some College	48 (34.3)
Bachelor's Degree	18 (12.9)
Advanced Degree	11 (7.9)
Trade School	9 (6.4)
Employment, *n* (%)	
Employed Full-Time/Part-Time	29 (20.7)
Unemployed	68 (48.6)
Other	43 (30.7)

Note: Percentages may not sum to 100% because of rounding.
SD = standard deviation.

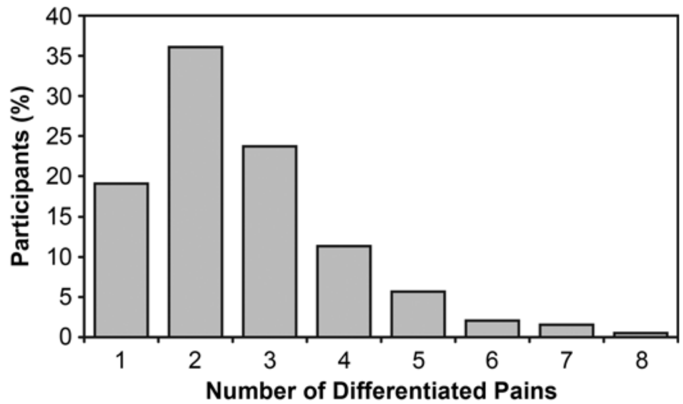

Figure 1.
Number of differentiated pains reported by all participants with spinal cord injury and chronic pain (n = 194).

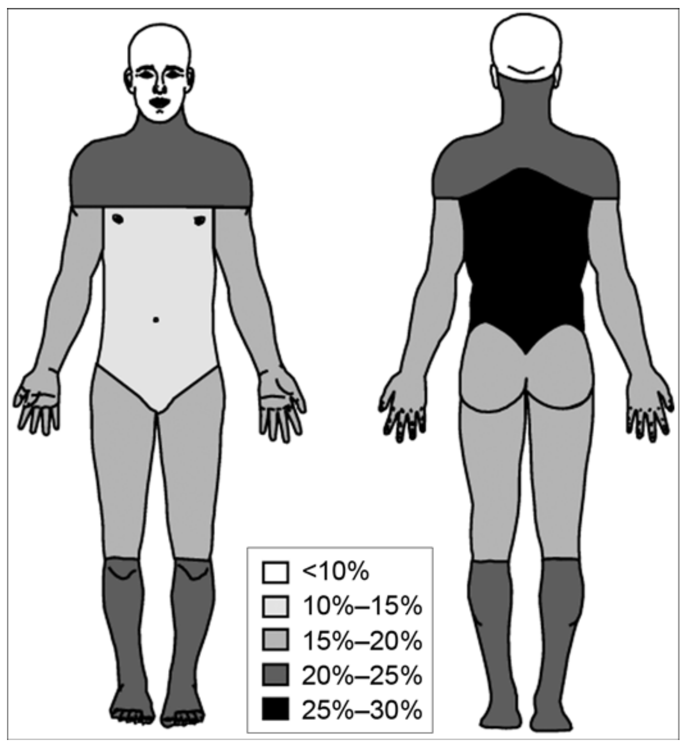

Figure 2.
Prevalence of pain locations. Participants outlined areas on drawing where they experienced chronic pain. Percentages are based on total number of pains identified (n = 488). Body maps were divided into eight regions for analysis (see main text for full description).

divided into eight body regions [27,39], and a tally was recorded for a region if any part of that region was included in the participant's outline for a particular pain. Relative to all described pains, the back was the most frequent pain location (29.5%), followed by the legs and feet (21.7%), the neck and shoulder region (21.5%), the upper portion of the legs (19.6%), the arm and hand region (17.8%), the buttocks (16.4%), the front torso and genital region (12.7%), and the head (2.9%).

The frequency with which each of the descriptive words was chosen is listed in **Table 2**. The participants

Table 2.
Frequency of words participants with spinal cord injury most commonly chose to describe their chronic pains.

Descriptor	% Overall (n = 480)	% MD Pains (n = 140)	% LD Pains (n = 140)	p-Value (uncorrected)
Burning	39.3	43.6	33.6	0.07
Aching	37.1	42.9	38.6	0.47
Sharp	33.3	51.4	22.1	<0.001*
Throbbing	22.9	25.7	21.4	0.34
Stabbing	20.4	30.0	14.3	0.002*
Electric	19.0	22.9	16.4	0.11
Penetrating	17.9	26.4	15.7	0.01
Stinging	17.5	21.4	14.3	0.10
Shooting	15.6	18.6	10.7	0.03
Pinching	15.4	22.1	12.9	0.03

Note: Most disturbing (MD) pains were identified as "most disturbing" of all chronic pains identified by subject. Less disturbing (LD) pains were matched chronic pains determined for each subject (see main text for full description).
*McNemar symmetry chi-square tests showed significant differences between proportion of MD pains compared with matched LD pains described with this word ($p < 0.05$, Bonferroni-corrected for 10 tests).

most frequently chose "burning," "aching," and "sharp" to describe the chronic pains that they experienced. More than 30 percent of all pains were described with each of these adjectives.

Pairwise Comparisons Between Most Disturbing and Less Disturbing Pains

Each participant reporting more than one pain and identifying one of these pains as the MD was included in the following analyses (n = 140). Each participant's MD and LD matched pair was determined as described in the "Methods" section.

Location of Pain

MD and LD pains did not significantly differ with regards to the location of pain (McNemar matched-pairs chi-square test; n = 140; $0.07 < p < 0.85$, uncorrected) for any of the body locations (i.e., head, neck and shoulder, arms and hands, front torso and genital region, back, buttocks, thighs, and lower legs and feet) (**Figure 3**). However, pains located at the LOI were significantly more often regarded as MD than LD (n = 128, χ^2 = 4.491, p = 0.03; **Figure 4**).

Verbal Descriptors

We compared the distributions of the 10 most commonly chosen descriptors (i.e., burning, aching, sharp, throbbing, stabbing, electric, penetrating, stinging, shooting, and pinching) between MD and matched LD pains. Using the McNemar symmetry chi-square test for dependent samples, we found that a significantly greater number of MD pains were labeled "sharp" and "stabbing" ($p < 0.05$, corrected) compared with LD pains (**Table 2**); no other descriptors reached significance (α = 0.05) after correction for 10 tests. In addition, the number of descriptors chosen for MD pains was significantly greater than the number of descriptors chosen for LD pains ($p < 0.001$). The possible range, mean, standard deviation of difference, Z-score, and p-value results for the number of descriptors and all other tests subsequently reported can be found in **Table 3**.

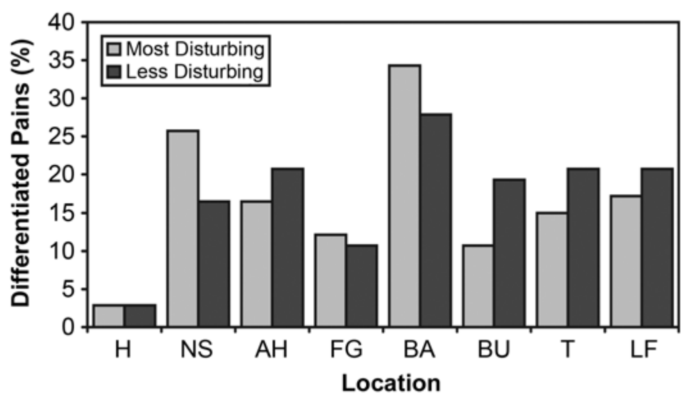

Figure 3.
Location of participants' (n = 140) most disturbing and less disturbing pains. H = head, NS = neck and shoulders, AH = arms and hands, FG = front torso and genital region, BA = back, BU = buttocks, T = thighs, LF = legs and feet.

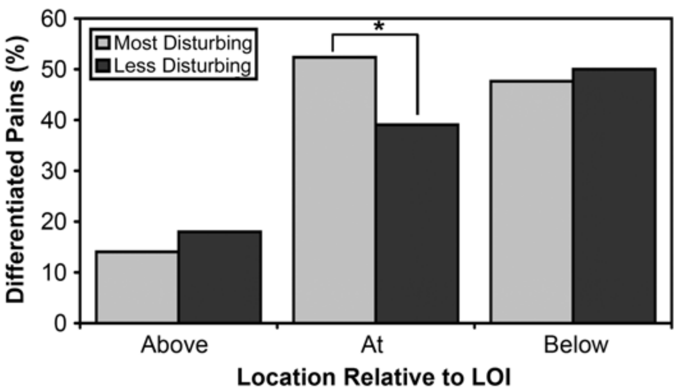

Figure 4.
Location of participants' pain areas relative to their level of injury (LOI) (n = 128). Above-level pains were more than two dermatomal levels above neurologically determined LOI. At-level pains were at neurologically determined LOI, plus two dermatomes above and below this level. Below-level pains were more than two dermatomal levels below neurologically determined LOI. *McNemar symmetry chi-square analysis showed significant differences between proportion of most disturbing pains that were located at LOI, compared with matched less disturbing pains (p = 0.03).

Other Characteristics of Pain

Pain intensity ratings (p < 0.001) and pain unpleasantness ratings (p < 0.001) were significantly different for pains classified as MD compared with LD. Matched-pairs sign tests revealed that MD and LD pains also significantly differed on measures of pain interference (p < 0.001), aggravating factors (p = 0.001), temporal constancy of pain (p = 0.018), and neuropathic painlike characteristics (p = 0.017). Details of these results can be found in **Table 3**.

Internal Consistency of Derived Scores

Scores for pain interference, aggravating factors, temporal constancy, and neuropathic pain, which were based on combined answers from the pain history questionnaire, have not previously been psychometrically assessed. To provide a measure of internal consistency, we determined Cronbach α values. Cronbach α was 0.68 for the pain interference score, 0.62 for the neuropathic pain score, and 0.90 for the aggravating factors score. Based on these Cronbach α values and Shrout's recommendations [51], the pain interference score and the neuropathic pain score have "moderate" internal consistency and the aggravating factors score has "substantial" internal consistency. The temporal constancy score included two questions, each aimed at assessing a different component of the temporal aspects of pain; these two questions were significantly correlated (Pearson r = 0.40).

Logistic Regression

A conditional logistic regression [47] was performed to examine the predictive capability of combined factors to define a specific pain as the MD. To assess possible multicollinearity between variables, we calculated correlation coefficients between all the variables that significantly distinguished between MD and LD pains in the matched-pairs analyses. A correlation coefficient of 0.70 was used as the cutoff for multicollinearity, and only one pair of variables, pain intensity and pain unpleasantness ratings, exceeded this cutoff (r = 0.76). The unpleasantness rating was removed from the regression analysis, since pain intensity is more commonly used in the literature as an outcome measure for pain [52–53].

The following factors for each of the MD and LD pains were entered into the model: (1) the descriptor

Table 3.
Matched-pairs comparisons between participants' most disturbing (MD) and less disturbing (LD) pains associated with spinal cord injury.

Measure	*n*	Range	MD Group Mean	LD Group Mean	SD of Differences	*Z*-score*	*p*-Value*
No. of Descriptors	140	0–24	4.50	3.06	3.47	5.10	<0.001
Pain Intensity NRS	138	0–10	7.29	5.88	2.37	6.63	<0.001
Pain Unpleasantness NRS	137	0–10	7.71	6.63	2.47	5.70	<0.001
Pain Interference Score	140	0–17	11.96	10.74	3.04	5.14	<0.001
Aggravating Factors Score	140	0–35	9.54	8.52	3.01	3.30	0.001
Constancy of Pain Score	140	0–10	7.15	6.68	2.12	2.37	0.018
Neuropathic Pain Score	140	0–10	3.55	2.91	1.98	2.38	0.017

*Sign test.
NRS = numerical rating scale, SD = standard deviation.

"sharp," (2) the descriptor "stabbing," (3) the location of at-level relative to LOI, (4) the pain intensity rating, (5) the number of descriptors used to describe a pain, (6) the pain interference score, (7) the aggravating factors score, (8) the constancy of pain score, and (9) the neuropathic pain score. The overall logistic model included a combination of five predictors and was highly significant ($p < 0.001$). The likelihood that a pain was selected as MD was related to the pain (1) being described as "sharp" ($p < 0.001$), (2) having a high pain intensity rating ($p = 0.001$), (3) having a high pain interference score ($p = 0.004$), (4) having a high aggravating factors score ($p = 0.015$), and (5) having a high constancy of pain score ($p = 0.040$). The Nagelkerke pseudo-R^2 value was 0.68, suggesting a strong association between MD pain and the combined independent variables in the regression [54]. In addition, the probability of each of the variables predicting the MD pain is demonstrated by the OR values between 1.53 and 13.34. The detailed model fitting information and the likelihood ratio tests are shown in **Table 4**.

DISCUSSION

In the SCI population, chronic pain is typically not one entity but often many types of pains [2,6–9,14–15], each with, perhaps, its own set of pain-generating and pain-maintaining mechanisms [24]. If a person has more than one type of pain, identifying the separate characteristics of these pains is important, since treatment responses for each pain type may differ. By carefully interviewing a person who experiences several types of SCI-related pain, one can obtain a pain history that allows for separate analysis of each pain.

In the present sample, 80.9 percent of participants reported having more than one type of chronic pain. This result is similar to a study by Turner and Cardenas [6], who reported that 83.3 percent of their sample had more than one pain problem, but is inconsistent with other studies that have reported somewhat lower percentages (57.5% [15], 61.5% [2], 65% [55], and 69% [8]). This inconsistency may be due to both differences in data collection methods and differences in inclusion criteria. The present results identify the back as the most common location for pain (29.5% of all differentiated pains, 68.0% of participants), which is similar in prevalence to reports in the literature (58.6% [56], 61% [57], and 61.8% [27] of participants). The most common descriptive words from the current study ("burning," "aching," and "sharp") were also the most prevalent descriptors in previously published data in persons with chronic pain and SCI [8,15,27,57].

Table 4.
Conditional logistic regression analysis predicting most disturbing pains.*

Variable	OR	95% CI	*p*-Value
Descriptor "Sharp"	13.34	3.45–51.63	<0.001
Pain Intensity Rating	1.57	1.19–2.07	0.001
Pain Interference Score	2.00	1.25–3.20	0.004
Aggravating Factors Score	1.65	1.10–2.48	0.01
Pain Constancy Score	1.53	1.02–2.30	0.04

*$\chi^2 = 91.75$, 5 degrees of freedom, $p < 0.001$.
CI = confidence interval, OR = odds ratio.

The emphasis of our analyses was on determining which factors influenced a person's perception of which pain he or she considered to be the MD compared with the other pains that he or she had. While intense pain is likely to contribute significantly to decreased emotional and physical function [13], other factors may also be important and contribute to the disturbing aspects of pain. Therefore, the characteristics of chronic pains that an individual perceives as disturbing are important to evaluate, since treatment strategies may be able to target these pain characteristics specifically [32–33].

Several characteristics of pain were significantly related to whether a person perceived a particular pain as being their MD pain. Not surprisingly, the intensity and unpleasantness ratings of pain were significantly higher for pains labeled MD compared with their matched LD counterparts. In addition, pains described by the words "sharp" and/or "stabbing" were more likely to be identified as MD pains. "Sharp" is generally agreed to represent sensory aspects of pain [58–61], which concurs with the higher pain intensity scores associated with the MD pains. Although MD and LD pains did not significantly differ with regard to specific body location, at-level pains were significantly more often identified as the MD pain than not (52% of MD pains vs 39% of LD pains were located at level, $p = 0.034$). This finding suggests that the pain location relative to the LOI may be a defining characteristic of MD pains. Classification schemes for SCI pain have identified locations of pain relative to the LOI [22–23] as having different characteristics, and possibly, different mechanisms [24]. Cardenas et al. reported that 55.6 percent of transition zone (at-level) pains were in the highest category (severe pain-related disability) of the Chronic Pain Grade questionnaire [15]. Similarly, Siddall and colleagues found that 60 percent of their participants with at-level neuropathic pain rated it as severe or excruciating, while only 48 percent of those with below-level neuropathic pain rated it as severe or excruciating [28]. Consistent with these reports, the present data revealed a significant association between a pain being perceived as MD and being located at the LOI. This association suggests that features commonly associated with at-level pains (e.g., allodynia, hyperalgesia, and/or dysesthesia) may contribute to the disturbing character of these pains. Paired comparisons also indicated that the number of neuropathic pain-associated symptoms (reflected by our neuropathic pain score) was greater for MD compared with LD pains. While intense pains of neuropathic origin are often primary targets for pain management, other aspects not necessarily related to pain type, such as pain interference, aggravating factors, and the constancy of pain, should also be considered in the overall evaluation and management of SCI-related pain.

The conditional logistic regression analysis confirmed many of our paired-comparison analyses, showing that a combination of higher pain intensity, more pain interference, multiple aggravating factors, and more constant pain, in addition to pain described as "sharp," could predict a pain being defined as MD ($p < 0.001$). In contrast, other variables, which had been shown to be significantly different for the pairwise comparisons (i.e., "stabbing," at-level, and neuropathic pain score), were not significant predictors of a pain being selected as MD in the regression analysis. The finding that pain intensity, constancy of pain, and aggravation of pain are associated with pains considered especially disturbing concurs with previous studies that found relationships among these aspects of pain in persons with SCI and chronic pain [15,27,44]. It also emphasizes the importance of evaluating the characteristics of each pain separately when planning the overall pain treatment strategy. The results of our conditional logistic regression analysis complement a mechanism-based treatment strategy because specific pain types and, thus, mechanisms, may underlie the signs and symptoms perceived as MD.

The finding that MD pains are intense and constant, interfere with daily living, and are aggravated by many factors adds to the body of literature that suggests that current treatments for pain in the SCI population are mostly insufficient [8,16–21]. Pains that are severe, exacerbated by various stimuli encountered on a daily basis, and constantly present are bound to significantly interfere with activities of life beyond the functional limitations imposed by the SCI itself. The results of the current study also emphasize that not only should spontaneous pain be thoroughly evaluated but also that evoked pain is a significant problem worthy of systematic evaluation in this population. Although methods for evaluating evoked pain have not been psychometrically tested in the SCI chronic pain population, such methods are frequently used in clinical and research settings [9,18,62]. Given the results of this study, which show that aggravating factors and neuropathic pain qualities are significantly higher for MD pains, assessment of evoked pain in the SCI chronic pain population, using both verbal reports and quantitative psychophysical methods, is essential. Interventions aimed at the reduction of symptoms such as aggravation of pain, in addition to reduction of pain constancy and interference with activities, may effectively complement a mechanism-based treatment intervention for improving quality of life in individuals with SCI and chronic pain.

The present study attempted to define the characteristics associated with pain perceived as MD compared with pains not designated as such. Some of the measures used to compare MD and LD pains (aggravating factors score, pain interference score, temporal constancy score, and neuropathic pain score) were based on a standardized pain history questionnaire. Although the Cronbach α values for these scores suggested moderate to substantial internal consistency, other psychometric properties have not been fully examined for these measures.

The pain characteristics found to significantly predict MD pains in this study may not be the only significant contributors to MD pain in all individuals with SCI. Therefore, the findings of the present study should be further confirmed in future prospective studies that use psychometrically well-defined instruments that have been validated for the assessment of each specific pain rather than for assessment of overall pain. Consistent with the Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials recommendations [63], future studies should also consider including an expanded assessment of pain interference and emotional function.

The present study applied a differentiated pain evaluation to each specific pain experienced by a person with SCI. For some measures, mean within-subject differences were small (**Table 3**). We suggest that these small differences may be because of difficulty differentiating between each pain for all interview questions, indicating that the differences between MD and LD pains may be, in reality, even greater than were found in the present study. Future studies should closely attend to the extent of pain differentiation a person can provide. We suggest that pain assessment methods be modified to provide brief, concise, and differentiated pain evaluation in order to improve the measurement of pain in populations in which several pain conditions are simultaneously present.

The construct “most disturbing pain” was not predefined so as to capture each participant’s individual assessment of his or her pains. Although the specific meaning of “most disturbing pain” is likely to differ from person to person, “disturbing” is commonly used by patients and in studies to describe pain [25–26]. Future undertakings with focus groups might further elucidate each participant’s definition of the MD pain.

Despite these limitations, the results of the present study show that distinct characteristics are associated with pains regarded as more disturbing compared with other less-disturbing pains.

CONCLUSIONS

Separately assessing individual signs and symptoms of pain is imperative, since these assessments provide a basis for both the classification of pain and the determination of particularly disturbing pain types. The results of the current study suggest that “sharp,” intense pain that is continuously present, frequently interferes with daily activities and sleep, and is aggravated by many events and circumstances is most likely to be perceived as the most disturbing in people with SCI who have more than one type of chronic pain. Given the refractory nature of many SCI-associated pains, we suggest further development of treatments that incorporate both a mechanism-based approach and individually tailored strategies to reduce pain’s impact on emotional and physical function. For example, implementing combination therapies aimed at reducing pain symptoms, such as coping strategies that distract attention away from pain or use of assistive devices and techniques that allow daily functioning without exacerbating pain, together with treatments targeting the underlying mechanisms of pain, may most effectively reduce the impact of SCI-related pain.

ACKNOWLEDGMENTS

We would like to acknowledge George Thomas, MD, and Alberto Martinez-Arizala, MD, for their help performing the ASIA examinations and Ms. Letitia Fisher and Mr. James Adcock for conducting interviews.

Dr. Felix is now also with the Department of Rehabilitation Medicine, University of Miami Miller School of Medicine, Miami, Florida.

This material was based on work supported by VA Rehabilitation Research and Development Service grants B3070R and B26566C, the State of Florida, and the Miami Project to Cure Paralysis (to Eva G. Widerström-Noga, DDS, PhD); and by the National Institutes of Health predoctoral training grant NS07492-06 and the Lois Pope LIFE Fellowship Program (to Yenisel Cruz-Almeida, MSPH).

The authors have declared that no competing interests exist.

REFERENCES

1. Kennedy P, Frankel H, Gardner B, Nuseibeh I. Factors associated with acute and chronic pain following traumatic spinal cord injuries. Spinal Cord. 1997;35(12):814–17. [PMID: 9429260]
2. Störmer S, Gerner HJ, Grüninger W, Metzmacher K, Föllinger S, Wienke C, Aldinger W, Walker N, Zimmermann M, Paeslack V. Chronic pain/dysaesthesiae in spinal cord injury patients: Results of a multicentre study. Spinal Cord. 1997;35(7):446–55. [PMID: 9232750]
3. Demirel G, Yllmaz H, Gençosmanolu B, Kesikta N. Pain following spinal cord injury. Spinal Cord. 1998;36(1):25–28. [PMID: 9471134]
4. Rintala DH, Loubser PG, Castro J, Hart KA, Fuhrer MJ. Chronic pain in a community-based sample of men with spinal cord injury: Prevalence, severity, and relationship with impairment, disability, handicap, and subjective well-being. Arch Phys Med Rehabil. 1998;79(6):604–14. [PMID: 9630137]
5. Dalyan M, Cardenas DD, Gerard B. Upper extremity pain after spinal cord injury. Spinal Cord. 1999;37(3):191–95. [PMID: 10213328]
6. Turner JA, Cardenas DD. Chronic pain problems in individuals with spinal cord injuries. Semin Clin Neuropsychiatry. 1999;4(3):186–94. [PMID: 10498786]
7. Widerström-Noga EG, Felipe-Cuervo E, Broton JG, Duncan RC, Yezierski RP. Perceived difficulty in dealing with consequences of spinal cord injury. Arch Phys Med Rehabil. 1999;80(5):580–86. [PMID: 10326925]
8. Ravenscroft A, Ahmed YS, Burnside IG. Chronic pain after SCI. A patient survey. Spinal Cord. 2000;38(10):611–14. [PMID: 11093322]

9. Finnerup NB, Johannesen IL, Sindrup SH, Bach FW, Jensen TS. Pain and dysesthesia in patients with spinal cord injury: A postal survey. Spinal Cord. 2001;39(5):256–62. [PMID: 11438841]
10. Levi R, Hultling C, Nash MS, Seiger A. The Stockholm spinal cord injury study: 1. Medical problems in a regional SCI population. Paraplegia. 1995;33(6):308–15. [PMID: 7644255]
11. Anson CA, Shepherd C. Incidence of secondary complications in spinal cord injury. Int J Rehabil Res. 1996;19(1): 55–66. [PMID: 8730544]
12. Westgren N, Levi R. Quality of life and traumatic spinal cord injury. Arch Phys Med Rehabil. 1998;79(11):1433–39. [PMID: 9821906]
13. Widerström-Noga EG, Felipe-Cuervo E, Yezierski RP. Chronic pain after spinal injury: Interference with sleep and daily activities. Arch Phys Med Rehabil. 2001;82(11): 1571–77. [PMID: 11689978]
14. Hanley MA, Masedo A, Jensen MP, Cardenas DD, Turner JA. Pain interference in persons with spinal cord injury: Classification of mild, moderate, and severe pain. J Pain. 2006;7(2):129–33. [PMID: 16459278]
15. Cardenas DD, Turner JA, Warms CA, Marshall HM. Classification of chronic pain associated with spinal cord injuries. Arch Phys Med Rehabil. 2002;83(12):1708–14. [PMID: 12474174]
16. Bowsher D. Central pain following spinal and supraspinal lesions. Spinal Cord. 1999;37(4):235–38. [PMID: 10338341]
17. Warms CA, Turner JA, Marshall HM, Cardenas DD. Treatments for chronic pain associated with spinal cord injuries: Many are tried, few are helpful. Clin J Pain. 2002;18(3): 154–63. [PMID: 12048417]
18. Widerström-Noga EG, Turk DC. Types and effectiveness of treatments used by people with chronic pain associated with spinal cord injuries: Influence of pain and psychosocial characteristics. Spinal Cord. 2003;41(11):600–9. [PMID: 14569261]
19. Cardenas DD, Jensen MP. Treatments for chronic pain in persons with spinal cord injury: A survey study. J Spinal Cord Med. 2006;29(2):109–17. [PMID: 16739554]
20. Burchiel KJ, Hsu FP. Pain and spasticity after spinal cord injury: Mechanisms and treatment. Spine. 2001;26(24 Suppl): S146–60. [PMID: 11805622]
21. Cruz-Almeida Y, Martinez-Arizala A, Widerström-Noga EG. Chronicity of pain associated with spinal cord injury: A longitudinal analysis. J Rehabil Res Dev. 2005;42(5): 585–94. [PMID: 16586184]
22. Bryce TN, Ragnarsson KT. Pain after spinal cord injury. Phys Med Rehabil Clin N Am. 2000;11(1):157–68. [PMID: 10680163]
23. Siddall PJ, Yezierski RP, Loeser JD. Pain following spinal cord injury: Clinical features, prevalence, and taxonomy. IASP Newsletter. 2000;3:3–7.
24. Finnerup NB, Jensen TS. Spinal cord injury pain—Mechanisms and treatment. Eur J Neurol. 2004;11(2):73–82. [PMID: 14748766]
25. Frich LM, Borgbjerg FM. Pain and pain treatment in AIDS patients: A longitudinal study. J Pain Symptom Manage. 2000; 19(5):339–47. [PMID: 10869874]
26. Cheung KL. Management of cyclical mastalgia in oriental women: Pioneer experience of using gamolenic acid (Efamast) in Asia. Aust N Z J Surg. 1999;69(7):492–94. [PMID: 10442919]
27. Widerström-Noga EG, Felipe-Cuervo E, Yezierski RP. Relationships among clinical characteristics of chronic pain after spinal cord injury. Arch Phys Med Rehabil. 2001;82(9): 1191–97. [PMID: 11552190]
28. Siddall PJ, McClelland JM, Rutkowski SB, Cousins MJ. A longitudinal study of the prevalence and characteristics of pain in the first 5 years following spinal cord injury. Pain. 2003;103(3):249–57. [PMID: 12791431]
29. Eide PK, Jørum E, Stenehjem AE. Somatosensory findings in patients with spinal cord injury and central dysaesthesia pain. J Neurol Neurosurg Psychiatry. 1996;60(4):411–15. [PMID: 8774406]
30. Beric A. Altered sensation and pain in spinal cord injury. In: Dimitrijevic MR, Wall PD, Lindblom U, editors. Recent achievements in restorative neurology. Vol 3. Basel (Switzerland): Karger; 1990. p. 27–36.
31. Defrin R, Ohry A, Blumen N, Urca G. Characterization of chronic pain and somatosensory function in spinal cord injury subjects. Pain. 2001;89(2–3):253–63. [PMID: 11166482]
32. Scholz J, Woolf CJ. Can we conquer pain? Nat Neurosci. 2002;5 Suppl:1062–67. [PMID: 12403987]
33. Woolf CJ, Salter MW. Neuronal plasticity: Increasing the gain in pain. Science. 2000;288(5472):1765–69. [PMID: 10846153]
34. Siddall PJ, Cousins MJ. Persistent pain as a disease entity: Implications for clinical management. Anesth Analg. 2004; 99(2):510–20. [PMID: 15271732]
35. Widerström-Noga EG, Cruz-Almeida Y, Martinez-Arizala A, Turk DC. Internal consistency, stability, and validity of the spinal cord injury version of the multidimensional pain inventory. Arch Phys Med Rehabil. 2006;87(4):516–23. [PMID: 16571391]
36. American Spinal Injury Association, International Medical Society of Paraplegia, American Paralysis Association. International standards for neurological and functional classification of spinal cord injury. Chicago (IL): American Spinal Injury Association; 2000.
37. Maynard FM Jr, Bracken MB, Creasey G, Ditunno JF, Donovan WH, Ducker TB, Garber SL, Marino RJ, Stover SL, Tator CH, Waters RL, Wilberger JE, Young W. International standards for neurological and functional classification of spinal cord injury. American Spinal Injury Association. Spinal Cord. 1997;35(5):266–74. [PMID: 9160449]

38. Widerström-Noga EG. Evaluation of clinical characteristics of pain and psychosocial factors after spinal cord injury. Prog Pain Res Manage. 2002;23:53–84.
39. Margolis RB, Chibnall JT, Tait RC. Test-retest reliability of the pain drawing instrument. Pain. 1988;33(1):49–51. [PMID: 3380550]
40. Davidoff G, Roth E, Guarracini M, Sliwa J, Yarkony G. Function-limiting dysesthetic pain syndrome among traumatic spinal cord injury patients: A cross-sectional study. Pain. 1987;29(1):39–48. [PMID: 3588000]
41. Melzack R, Torgerson S. On the language of pain. Anesthesiology. 1971;34(1):50–59. [PMID: 4924784]
42. Nepomuceno C, Fine PR, Richards JS, Gowens H, Stover SL, Rantanuabol U, Houston R. Pain in patients with spinal cord injury. Arch Phys Med Rehabil. 1979;60(12):605–9. [PMID: 518270]
43. Jensen MP, Turner JA, Romano JM, Fisher LD. Comparative reliability and validity of chronic pain intensity measures. Pain. 1999;83(2):157–62. [PMID: 10534586]
44. Widerström-Noga EG, Turk DC. Exacerbation of chronic pain following spinal cord injury. J Neurotrauma. 2004; 21(10):1384–95. [PMID: 15672629]
45. Widerström-Noga EG. Chronic pain and nonpainful sensations after spinal cord injury: Is there a relation? Clin J Pain. 2003;19(1):39–47. [PMID: 12514455]
46. Widerström-Noga EG, Cruz-Almeida Y, Krassioukov A. Is there a relationship between chronic pain and autonomic dysesthetic in persons with cervical spinal cord injury? J Neurotrauma. 2004;21(2):195–204. [PMID: 15000760]
47. Price DD, Bush FM, Long S, Harkins SW. A comparison of pain measurement characteristics of mechanical visual analogue and simple numerical rating scales. Pain. 1994;56(2): 217–26. [PMID: 8008411]
48. Rosner B. Fundamentals of biostatistics. 3rd ed. Boston (MA): PWS-Kent; 1990.
49. Chan YH. Biostatistics 305. Multinomial logistic regression. Singapore Med J. 2005;46(6):259–68. [PMID: 15902353]
50. Kleinbaum DG. Applied regression analysis and other multivariable methods. 3rd ed. Pacific Grove (CA): Duxbury Press; 1998.
51. Shrout PE. Measurement reliability and agreement in psychiatry. Stat Methods Med Res. 1998;7(3):301–17. [PMID: 9803527]
52. Jensen MP. The validity and reliability of pain measures in adults with cancer. J Pain. 2003;4(1):2–21. [PMID: 14622723]
53. Bradley LA. Pain measurement in arthritis. Arthritis Care Res. 1993;6(4):178–86. [PMID: 7918713]
54. Nagelkerke NJ. A note on a general definition of the coefficient of determination. Biometrika. 1991;78(3):691–92.
55. Barrett H, McClelland JM, Rutkowski SB, Siddall PJ. Pain characteristics in patients admitted to hospital with complications after spinal cord injury. Arch Phys Med Rehabil. 2003;84(6):789–95. [PMID: 12808528]
56. Turner JA, Jensen MP, Warms CA, Cardenas DD. Catastrophizing is associated with pain intensity, psychological distress, and pain-related disability among individuals with chronic pain after spinal cord injury. Pain. 2002;98(1–2):127–34. [PMID: 12098624]
57. Turner JA, Cardenas DD, Warms CA, McClellan CB. Chronic pain associated with spinal cord injuries: A community survey. Arch Phys Med Rehabil. 2001;82(4):501–9. [PMID: 11295011]
58. Melzack R, Katz J. Pain assessment in adult patients. In: McMahon S. Koltzenburg M, editors. Wall and Melzack's textbook of pain. Edinburgh (Scotland): Churchill Livingstone; 2005.
59. Wright KD, Asmundson GJ, McCreary DR. Factorial validity of the short-form McGill pain questionnaire (SF-MPQ). Eur J Pain. 2001;5(3):279–84. [PMID: 11558983]
60. Beattie PF, Dowda M, Feuerstein M. Differentiating sensory and affective-sensory pain descriptions in patients undergoing magnetic resonance imaging for persistent low back pain. Pain. 2004;110(1–2):189–96. [PMID: 15275767]
61. Reading AE, Everitt BS, Sledmere CM. The McGill Pain Questionnaire: A replication of its construction. Br J Clin Psychol. 1982;21(Pt 4):339–49. [PMID: 7171883]
62. Finnerup NB, Sindrup SH, Bach FW, Johannesen IL, Jensen TS. Lamotrigine in spinal cord injury pain: A randomized controlled trial. Pain. 2002;96(3):375–83. [PMID: 11973012]
63. Turk DC, Dworkin RH, Allen RR, Bellamy N, Brandenburg N, Carr DB, Cleeland C, Dionne R, Farrar JT, Galer BS, Hewitt DJ, Jadad AR, Katz NP, Kramer LD, Manning DC, McCormick CG, McDermott MP, McGrath P, Quessy S, Rappaport BA, Robinson JP, Royal MA, Simon L, Stauffer JW, Stein W, Tollett J, Witter J. Core outcome domains for chronic pain clinical trials: IMMPACT recommendations. Pain. 2003;106(3):337–45. [PMID: 14659516]

Submitted for publication December 15, 2006. Accepted in revised form May 7, 2007.