Classification of Low Back-Related Leg Pain: Do Subgroups Differ in Disability and Psychosocial Factors?

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Treating regional musculoskeletal dysfunctions as relatively homogenous disorders has been criticized as being "too generalised to serve a useful purpose in contemporary practice"[1]. In support of this idea, sub-classification of low back pain has been recommended as enabling the application of specific interventions tailored for these groups, which is likely to enhance treatment efficacy[2]. Following the classification theme, it has been proposed that a variety of causes of low back-related leg pain[3] exist and that the low back-related leg pain population is a heterogeneous group. A classification system to sub-classify low back-related leg pain has been proposed[3] that extends the ideas originally presented by Elvey and Hall[4]. Schafer et al[3] have proposed sub-classification based on the predominant underlying patho-mechanism causing low back-related leg pain.

Within this system, four distinct subgroups have been proposed. In summary, these comprise Central Sensitization (CS, predominance of positive symptoms arising from central nervous system sensitization), Denervation (D, arising from significant axonal compromise and the resulting reduction in axonal conductivity), Peripheral Nerve Sensitization (PNS, arising from nerve trunk inflammation causing increased axonal mechanosensitivity) and Musculoskeletal (M, pain referred to the leg from non-neural structures such as the lumbar intervertebral disc)[3]. It is recognized that patients with low back-related leg pain may have an overlap of such mechanisms; hence, sub-grouping is carried out in a hierarchical process with priority given to CS followed by D, PNS, and finally M.

The classification process is carried out by a comprehensive examination protocol, which incorporates various aspects of the subjective and physical examination[3]. Positive symptoms of neuropathic pain are identified by the Leeds Assessment of Neuropathic Symptoms and Signs (LANSS) questionnaire[5]. While the original intention of this scale was to identify neuropathic pain, all items on this questionnaire seek to identify positive features that are associated with central mechanisms. A positive LANSS suggests that neuropathic mechanisms of pain are present with a dominance of central mechanisms[3]. Axonal conduction loss is recognized by a routine neurological examination incorporating tendon reflexes, skin sensation, and muscle power. Nerve tissue mechano-sensitivity is determined by neural tissue provocation tests, such as the straight leg raise (SLR) test, the slump test, and nerve palpation[6].

The first step in validating a new classification system is to identify whether subgroups can be identified consis-

ABSTRACT: It has been proposed that patients with low back-related leg pain can be classified according to pain mechanisms into four distinct subgroups: Central Sensitization (CS), Denervation (D), Peripheral Nerve Sensitization (PNS), and Musculoskeletal (M). The purpose of this study was to determine whether there were any differences in terms of disability and psychosocial factors between these four subgroups. Forty-five subjects with low back-related leg pain completed the Oswestry Disability Index, the Hospital Anxiety and Depression Scale, and the Fear Avoidance Beliefs Questionnaire. Subsequently, an examiner blinded to the questionnaire results classified the subjects into one of the four subgroups, according to the findings of the self-administered Leeds Assessment of Neuropathic Signs and Symptoms questionnaire and a physical examination. It was found that the PNS subgroup had significantly greater disability compared to all other subgroups and significantly greater fear avoidance beliefs about physical activity compared to the CS and D subgroups. This highlights the importance of sub-classification but also the need to take into account disability and psychosocial factors in the management of low back-related leg pain.

KEYWORDS: Classification, Disability, Low Back-Related Leg Pain, Psychosocial Factors

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tently and repeatedly without error[7]. Schafer et al[8] examined the reliability of the classification system. Forty patients with low back-related leg pain were independently assessed by five pairs of examiners using the examination protocol. Interrater reliability was good with 80% agreement between examiners and a κ of 0.72.

Predictive validity of the classification protocol has been tested by investigating differences in somatosensory profiles of subjects classified by this process using quantitative sensory testing[9]. Significant differences in sensory thresholds were found in groups, which support the mechanism-based classification system.

Reliable and valid identification of homogenous subgroups may enable the application of specific interventions, which may be more likely to be effective than non-specific interventions. For example, treatment driven by subclassification has been shown to be superior to generic treatment for low back pain[10,11]. However, intervention outcome may also depend on other factors. Although uncertainty remains regarding which factors are associated with particular outcomes[12], it is well known that the level of disability and the presence of psychosocial factors influence the outcome of interventions for low back pain[13]. While different pathomechanisms of low back-related leg pain may be used to subdivide a heterogeneous group into the more homogenous subgroups detailed above, whether these subgroups differ in terms of disability and psychosocial factors is unknown. Subsequently, the aim of this study was to determine whether there were any differences in disability or psychosocial factors between the four subgroups of patients with low back-related leg pain.

Methods

A cross-sectional study design was used to investigate the relationship between disability and psychosocial factors and the classification of low back-related leg pain. Ethical approval was granted by the St. James's Hospital/Adelaide and Meath hospitals incorporating the National Children's Hospital Joint Research Ethics Committee. Subjects were able to withdraw from the study at any time and gave written informed consent prior to the study commencement.

Subjects

Subjects were recruited from consecutive patients attending the Back Pain Screening Clinic (BPSC) at the Adelaide and Meath hospitals incorporating the National Children's Hospital (AMNCH), Dublin, in June/July 2007. Patients were referred to the BPSC by general practitioners in the hospital's jurisdiction, AMNCH Accident and Emergency Department, or AMNCH hospital consultants[14]. The purpose of the clinic was to screen patients with low back pain to fast-track them to appropriate management. All patients underwent screening examination by one of two attending BPSC physiotherapists as routine. Recruitment was based on presenting symptoms as determined during this examination. Consecutive patients who satisfied the inclusion criteria (presence of low back-related leg pain, able to understand English, age 18–70) and were not disqualified by the exclusion criteria (absence of leg pain, signs of serious pathology, history of spinal surgery or neurological disease, unable to tolerate testing process) were invited to participate in the study.

Procedure

All participating subjects completed the Oswestry Disability Index (ODI), the Hospital Anxiety and Depression Scale (HADS), and the Fear-Avoidance Beliefs Questionnaire (FABQ). The ODI is a self-administered questionnaire that yields a percentage score: 0-20% is categorized as minimal disability; 20–40 as moderate; 40–60 as severe; 60–80 as crippled; and >80 as bedbound or exaggerating[15]. This questionnaire has been shown to be a reliable and valid measure of disability[16,17]. The HADS is also a self-administered questionnaire, consisting of seven statements in relation to anxiety (HADS-A) and seven in relation to depression (HADS-D). Each question is scored and a total score is calculated for each variable. A score of 0 to 7 is considered "normal," 8 to 10 as "borderline abnormal," and 11 to 21 as "abnormal" for each variable[18]. This has been shown to be a robust measuring tool for anxiety and depression[19]. The FABQ measures how much fear and avoidance about work and physical activity are affecting a person with low back pain. This questionnaire contains a number of statements in relation to how much physical activity or work affects the pain. The fear avoidance beliefs about work (FABQ-W) scale has a total score of 42 (7 items), while the fear avoidance beliefs about physical activity (FABQ-PA) scale has a maximum score of 24 (4 items). For both scales the higher the score, the greater the fear and avoidance beliefs shown by the patient for physical activity or work[20].

Subjects also completed the self-administered Leeds Assessment of Neuropathic Symptoms and Signs (S-LANSS) questionnaire. The S-LANSS is similar to the LANSS but without the need for clinical physical examination and has been shown to be a valid and reliable self-report instrument for neuropathic pain[21]. A score of 12 or more was recorded as positive and indicative of the presence of central sensitization[9]. A 10cm visual analogue scale (VAS) was used so that the patient could rate his or her average pain intensity, on the day of testing, according to this scale.

A physical examination, incorporating tests of neurological conduction (muscle power, reflexes, and skin sensitivity to light touch and pinprick) and tests of peripheral nerve sensitization (nerve palpation, SLR, and slump tests)[3] was performed by an examiner who was blinded to the results of all questionnaires.

Classification

Subjects were classified into one of four subgroups according to the hierarchical algorithm proposed by Schafer et al[3] as illustrated in Figure 1. Subjects were classified into the CS group if they scored 12 or more on the S-LANSS. If they scored less than 12 on the S-LANSS, they were classified according to the findings of the physical examination. A positive finding on neurological con-

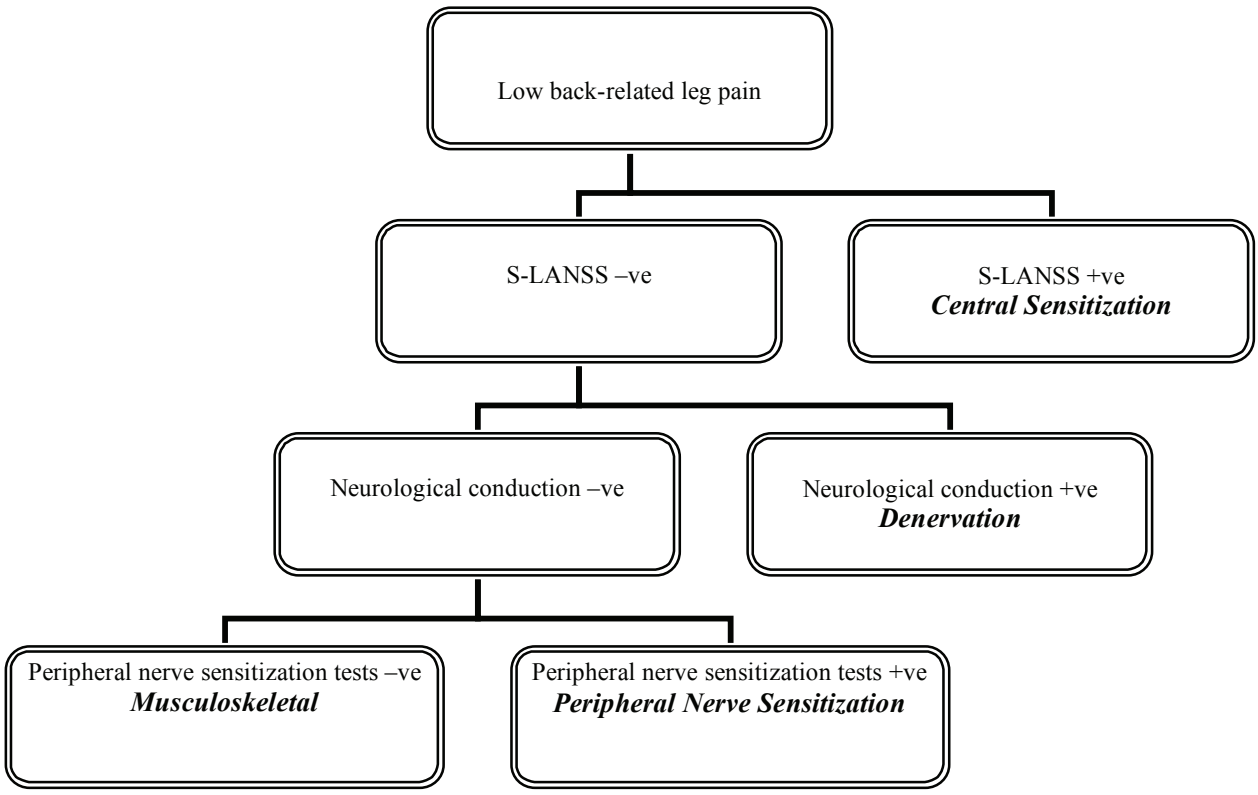

FIGURE 1. Classification Flowchart.

S-LANSS = self-administered Leeds Assessment of Neuropathic Symptoms and Signs questionnaire
+ve: positive, –ve: negative

duction examination led to classification in the D subgroup. Subjects who were negative on neurological examination were classified as either in the PNS subgroup if the peripheral nerve sensitization examination was positive or in the M subgroup if this was negative.

Data Analysis

Data were analysed using the Statistical Package for Social Sciences (SPSS) version 15.0. The Kolmogorov-Smirnov test was used to test for normality. Although all data were normally distributed, considering the small, unequal sample size in each subgroup, both parametric and non-parametric statistical tests were performed. The parametric one-way analysis of variance (ANOVA) statistic was used to determine whether there were any significant differences in mean scores for ODI, HADS-A, HADS-D, FABQ-W, FABQ-PA, and VAS between the four subgroups. In the event that any significant differences were found, post-hoc analysis was performed using Gabriel's test, to determine which subgroups differed. Gabriel's test should be used for post-hoc analysis of one-way ANOVA when the groups are of unequal numbers[22]. In addition, as a conservative measure of difference, a non-parametric Kruskall-Wallis test was used to determine whether there were any significant differences in median scores for each variable between the four subgroups. A significance level of $p < 0.05$ was set for all tests.

Results

Participants

Of 134 consecutive new patients attending the BPSC, 55 were excluded from the study for the following reasons: absence of leg pain (47), unable to understand English (3), history of spinal surgery (1), suspected serious pathology (3), and unable to tolerate testing position (1). Therefore, 79 patients were invited to take part; 34 declined and 45 subjects participated. Characteristics of the 45 study patients are detailed in Table 1.

Classification

Fifteen subjects (33%) were classified into the CS subgroup, 7 (16%) into the D subgroup, 11 (24%) into the PNS subgroup, and 12 (27%) into the M subgroup.

Differences between Groups

Mean scores and standard deviations (SD) for the disability, psychosocial, and pain intensity variables are detailed in Table 2. Although there appears to be a trend for higher mean scores for most of the variables, among the PNS subgroup,

TABLE 1. Participant characteristics.

Characteristic	Value
Gender	
Male	22
Female	23
Age	
Mean (SD)	46 (11) years
Range	26–70 years
Mean (SD) Duration of Symptoms	5.6 (5.7) months
Mean (SD) Pain Intensity	6.1(2.6)/10

one-way ANOVA revealed that the differences in means between subgroups for ODI and FABQ-PA were statistically significant; the others were not (Table 2).

Median scores and interquartile ranges (IQR) for each of the variables are detailed in Table 3. Similar to ANOVA findings, the Kruskall-Wallis test revealed that the differences in medians between subgroups for ODI and FABQ-PA were statistically significant, while the others were not (Table 3).

Gabriel's tests revealed that for ODI, the PNS subgroup score was significantly higher than that of all other subgroups ($p = 0.02$, 0.02, and <0.01 for CS, D, and M groups, respectively). A score of 52 falls into the "severe" disability category, as opposed to the other three subgroups, which had scores ranging from 30 to 37, which all fall into the "moderate" disability category.

For FABQ-PA, the PNS subgroup (20/24) scored significantly higher than the CS (16/24, $p = 0.04$) and D (12/24, $p < 0.01$) subgroups, but not the M (18/24, $p = 0.60$) subgroup, while there was also a significant difference between the M subgroup and the D subgroup ($p = 0.01$).

In relation to HADS-A, although the CS and peripheral PNS subgroups both had scores in the "borderline abnormal" range, while the other two subgroups scored "normal," these differences were not statistically significant. Similarly, although the PNS subgroup scored in the "borderline abnormal" range for HADS-D, while the other subgroups scored "normal," this difference was not statistically significant. All subgroups scored very similarly for FABQ-W. In terms of pain intensity, the PNS subgroup scored highest on the VAS, while the M subgroup scored lowest, although these differences were not statistically significant.

Discussion

These findings present a profile of disability and psychosocial factors among the combined sample of subjects with low back-related leg pain as well as its four subgroups. It is of note that the mean ODI score for the entire sample (low back-related leg pain group) was 38, which falls in the "moderate" disability category. Furthermore, this group was "borderline abnormal" in terms of anxiety (mean HADS-A = 8), had a relatively high degree of fear avoidance beliefs about physical activity (mean FABQ-PA = 17/24), and had a mean VAS for pain intensity of 6. This outlines the seriousness of low back-related leg pain and may help explain why this group accounts for a disproportionately large amount of the costs of medical care and disability compensation caused by low back pain[23].

In the present study, 33%, 16%, 24%, and 27% of the low back-related leg pain group were classified into the CS, D, PNS, and M subgroups, respectively. This compares with 26%, 36%, 12%, and 26% for the CS, D, PNS, and M subgroups, respectively, as determined by Hall et al[9]. The main differences between the two studies appear to be a higher proportion of subjects in the PNS subgroup and a lower proportion in the D subgroup in the present study. This may be explained by the fact that subjects in the present study were recruited from a BPSC, where more than 90% of the referrals come directly from the patients' general practitioners[14], while in the study of Hall et al, subjects were recruited from a private multidisciplinary pain clinic. The different group proportions may reflect differences in patient profiles at the individual clinics. Further studies are required to investigate group proportions in larger samples and in different clinic types. It must also be noted that while Hall et al used the LANSS, the S-LANSS was used in the present study; although as the S-LANSS is a self-report version of the LANSS[21], it may be expected that both would yield similar results.

It is interesting that the PNS subgroup scored significantly higher on the ODI compared to all other subgroups. In fact, this subgroup was categorized as being "severely" disabled, while the other subgroups were categorized as being "moderately" disabled. This highlights the need to identify this subgroup of the low back-related leg pain group so that this severe disability can be addressed. Despite this finding of greater disability, subjects with PNS are likely to respond to specific treatment aimed at desensitizing the neural tissue[24].

Similarly for FABQ-PA, the PNS subgroup scored significantly higher than the CS and D subgroups, indicating that the PNS subgroup had a greater degree of inappropriate beliefs in relation to physical activity, with resultant fear and avoidance of physical activity, compared to the CS and D subgroups. In the management of PNS, such inappropriate beliefs should be addressed.

With the exception of FABQ-W, the PNS subgroup also had higher mean scores for all of the other variables (HADS-A, HADS-D, VAS). However, this trend towards higher anxiety, depression, and pain intensity among the PNS subgroup was not statistically significant. This may be due to the sample size; a larger sample might have yielded significant results.

Central sensitization refers to the augmented response of central signalling neurons and involves heterosynaptic and homosynaptic mechanisms[25]. Descending modulatory pathways appear to influence central sensitization and thus neuropathic pain[25] as well as musculoskeletal pain[26]. There is evi-

TABLE 2. Mean (SD) scores for the disability, psychosocial, and pain intensity variables, with ANOVA for comparison of means between subgroups.

	Subgroups *(n)*						
	Leg pain (n=45)	CS (15)	D (7)	PNS (11)	M (12)	ANOVA	
	Mean (SD)					*F*	*p*
ODI	38(16)	37(15)	32(10)	52(17)	30(10)	6.34	0.001*
HADS-A	8(4)	9(4)	7(3)	10(4)	7(2)	1.93	0.14
HADS-D	6(4)	7(4)	5(3)	8(4)	5(3)	2.07	0.12
FABQ-PA	17(4)	16(3)	12(5)	20(4)	18(3)	7.57	<0.001*
FABQ-W	22(11)	22(11)	21(13)	21(11)	22(13)	0.04	0.99
VAS	6(3)	6(3)	6(3)	7(2)	5(3)	1.50	0.23

* statistically significant ($p < 0.05$)

TABLE 3. Median (IQR) scores for the disability, psychosocial, and pain intensity variables, with the Kruskall-Wallis test for comparison of medians between subgroups

	Subgroups *(n)*						
	Leg pain (n=45)	CS (15)	D (7)	PNS (11)	M (12)	Kruskall-Wallis	
	Median (IQR)					$\chi 2$	*p*
ODI	33(22)	34(26)	32(14)	47.5(25)	30(11)	12.2	0.007*
HADS-A	8(5)	9(8)	6(6)	9(7)	7(5)	4.9	0.18
HADS-D	6(5)	5(7)	6(6)	7(7)	3.5(4)	5.0	0.17
FABQ-PA	17(7)	16.5(4)	12(4)	22.5(7)	19(5)	14.0	0.003*
FABQ-W	23(21)	20(19)	13(21)	21.5(23)	25.5(24)	0.3	0.96
VAS	7(4)	6.5(3)	6(5)	8(5)	5.5(4)	4.8	0.19

* statistically significant ($p < 0.05$); X^2 = chi-square.

dence that impulses generated in forebrain centers can influence descending pain inhibitory and facilitatory systems in the brainstem that are clinically relevant[26]. Hence, activity generated in the forebrain appears to be capable of maintaining impulse production and pain facilitation[27]. It was therefore surprising that subjects with centrally mediated neuropathic pain had less evidence of fear avoidance and less disability than subjects with PNS.

It is unclear why in this study patients classified as PNS had greater fear avoidance beliefs and disability than the patients in the other three sub-groups, particularly group CS. One explanation may be the presence of neural tissue mechanosensitivity, which has a greater impact on movement and pain in the PNS group. Dilley et al[28] and Bove et al[29] showed that in a rat model, induced nerve inflammation leads to axonal mechano-sensitivity of a small proportion of C and A(delta) fibers. Such fibers respond to local pressure[29] and nerve stretch[28] at the inflamed site. The most responsive fibers fired to 3% stretch, which Dilley[28] hypothesized was within the range of nerve stretch seen during normal limb movements. Such nerve sensitization may therefore be potentially very disabling to the patient.

Our study findings demonstrate that there are differences in terms of disability and psychosocial factors between four subgroups of low back-related leg pain and these findings need to be taken into consideration when managing these disorders. However, the small sample sizes in the four subgroups must be borne in mind as a limitation of this study when interpreting these findings.

Conclusion

This study found differences in disability and psychosocial factors between subgroups of patients with low back-related leg pain. The PNS group had greater disability compared to the other subgroups

and greater fear avoidance beliefs in relation to physical activity compared to the CS and D groups. This highlights the importance of sub-classification and also the need to take into account disability and psychosocial factors in the assessment and management of low back-related leg pain.

REFERENCES

1. Moore AP, Jull G. Editorial for special issue of *Manual Therapy Journal* based on the Second International Conference on Movement Dysfunction. *Man Ther* 2006;11:167–168.
2. O'Sullivan PB. Classification of lumbo-pelvic pain disorders: Why is it essential for management? *Man Ther* 2006;11:169–170.
3. Schafer A, Hall T, Briffa K. Classification of low back-related leg pain: A proposed patho-mechanism-based approach. *Man Ther* 2008. 2009:14:222–230.
4. Elvey R, Hall T. Neural tissue evaluation and treatment. In: Donatelli R, ed. *Physical Therapy of the Shoulder*. 3rd ed. New York: Churchill Livingstone, 1997.
5. Bennett M. The LANSS Pain Scale: The Leeds assessment of neuropathic symptoms and signs. *Pain* 2001;92:147–157.
6. Hall TM, Elvey RL. Nerve trunk pain: Physical diagnosis and treatment. *Man Ther* 1999;4:63–73.
7. Ford J, Story I, O`Sullivan P, McMeeken J. Classification systems for low back pain: A review of the methodology for development and validation. *Phys Ther Rev* 2007;12:33–42.
8. Schafer GM, Hall TM, Ludtke K, Mallwitz J, Briffa NK. Interrater reliability for a new classification system for patients with low back-related leg pain. *IFOMT 2008*. Rotterdam, the Netherlands: Elsevier, 2008.
9. Hall T, Schäfer A, Rolke R, et al. QST profiles of subgroups of patients with sciatica: Do they differ? *12th World Congress on Pain*. Glasgow, UK, 2008.
10. Brennan GP, Fritz JM, Hunter SJ, Thackeray A, Delitto A, Erhard RE. Identifying subgroups of patients with acute/subacute "nonspecific" low back pain: Results of a randomized clinical trial. *Spine* 2006;31:623–631.
11. Fritz JM, Delitto A, Erhard RE. Comparison of classification-based physical therapy with therapy based on clinical practice guidelines for patients with acute low back pain: A randomized clinical trial. *Spine* 2003;28:1363–1371.
12. Kent PM, Keating JL. Can we predict poor recovery from recent-onset nonspecific low back pain? A systematic review. *Man Ther* 2008;13:12–28.
13. Koes BW, van Tulder MW, Ostelo R, Kim Burton A, Waddell G. Clinical guidelines for the management of low back pain in primary care: An international comparison. *Spine* 2001;26:2504–2513.
14. Curley AE, Cassells M, Cooke G, Dowling F. Physiotherapy-led low back pain triage: Results of the first two years. *Physiotherapy Ireland* 2004;25:3–9.
15. Fairbank JC, Couper J, Davies JB, O'Brien JP. The Oswestry Low Back Pain Disability questionnaire. *Physiotherapy* 1980;66:271–273.
16. Fairbank JC, Pynsent PB. The Oswestry Disability Index. *Spine* 2000;25:2940–2952.
17. Roland M, Fairbank J. The Roland-Morris Disability Questionnaire and the Oswestry Disability Questionnaire. *Spine* 2000;25: 3115–3124.
18. Zigmond AS, Snaith RP. The Hospital Anxiety and Depression Scale. *Acta Psychiatr Scand* 1983;67:361–370.
19. Herrmann C. International experiences with the Hospital Anxiety and Depression Scale: A review of validation data and clinical results. *J Psychosomatic Res* 1997;42:17–41.
20. Waddell G, Newton M, Henderson I, Somerville D, Main CJ. A Fear-Avoidance Beliefs Questionnaire (FABQ) and the role of fear-avoidance beliefs in chronic low back pain and disability. *Pain* 1993;52:157–168.
21. Bennett MI, Smith BH, Torrance N, Potter J. The S-LANSS score for identifying pain of predominantly neuropathic origin: Validation for use in clinical and postal research. *J Pain* 2005;6:149–158.
22. Bland M. *An Introduction to Medical Statistics*. 3rd ed. Oxford, UK: Oxford University Press, 2000.
23. Ren XS, Selim AJ, Fincke G, et al. Assessment of functional status, low back disability, and use of diagnostic imaging in patients with low back pain and radiating leg pain. *J Clin Epidemiol* 1999;52:1063–1071.
24. Schafer GM, Hall TM, Ludtke K, Muller G, Briffa NK. Classification of low back-related leg pain: Differences in treatment response between diagnostic groups. *IFOMT 2008*. Rotterdam, the Netherlands: Elsevier, 2008.
25. Campbell JN, Meyer RA. Mechanisms of neuropathic pain. *Neuron* 2006;52:77–92.
26. Zusman M. Forebrain-mediated sensitization of central pain pathways: 'Non-specific' pain and a new image for MT. *Man Ther* 2002;7:80–88.
27. Porreca F, Ossipov MH, Gebhart GF. Chronic pain and medullary descending facilitation. *Trends Neurosci* 2002;25:319–325.
28. Dilley A, Lynn B, Pang SJ. Pressure and stretch mechanosensitivity of peripheral nerve fibres following local inflammation of the nerve trunk. *Pain* 2005;117:462–472.
29. Bove GM, Ransil BJ, Lin HC, Leem JG. Inflammation induces ectopic mechanical sensitivity in axons of nociceptors innervating deep tissues. *J Neurophysiol* 2003;90: 1949–1955.