

---

## ORIGINAL ARTICLE

---

# Demographic Characteristics of Patients with Severe Neuropathic Pain Secondary to Failed Back Surgery Syndrome

---

Simon Thomson, MBBS, FRCA, FIPP, FFPMRCA\*; Line Jacques, MD, FRCSC†

\*Pain Clinic, Basildon and Thurrock University Hospitals, Basildon, U.K.; †Department of Neurosurgery, Montreal Neurological Institute and Hospital, Montreal, Canada

### ■ Abstract

**Background:** Neuropathic pain commonly affects the back and legs and is associated with severe disability and psychological illness. It is unclear how patients with predominantly neuropathic pain due to failed back surgery syndrome (FBSS) compare with patients with other chronic pain conditions.

**Aims:** To present data on characteristics associated with FBSS patients compared with those with complex regional pain syndrome, rheumatoid and osteoarthritis, and fibromyalgia.

**Methods:** The PROCESS (Prospective Randomized Controlled Multicenter Trial of the Effectiveness of Spinal Cord Stimulation, ISRCTN 77527324) trial randomized 100 patients to spinal cord stimulation ( $n = 52$ ) plus conventional medical management (CMM) or CMM alone ( $n = 48$ ). Baseline patient parameters included age, sex, time since last surgery, employment status, pain location and severity (visual analogue scale), health-related quality of life (HRQoL), level of disability, medication, and nondrug therapies. Reference population data was drawn from the literature.

**Results:** At baseline, patients in the PROCESS study had a similar age and gender profile compared with other conditions. PROCESS patients suffered from greater leg pain and

had lower HRQoL. PROCESS patients treatment cost was higher and they commonly took opioids, while antidepressants and nonsteroidal anti-inflammatory drugs were more often used for other conditions. Prior to baseline, 87% of patients had tried at least 4 different treatment modalities. **Conclusions:** Patients suffering from chronic pain of neuropathic origin following FBSS often fail to obtain adequate relief with conventional therapies (eg, medication, nondrug therapies) and suffer greater pain and lower HRQoL compared with patients with other chronic pain conditions. Neuropathic FBSS patients may require alternative and possibly more (cost-) effective treatments, which should be considered earlier in their therapeutic management. ■

**Key Words:** patient characteristics, failed back surgery syndrome, neuropathic pain, quality of life, treatment pathway

### INTRODUCTION

A large recent European survey estimated that 19% of adults have moderate to severe chronic pain.<sup>1</sup> Many respondents indicated their pain interfered so substantially with their activities of daily living that they could not maintain an independent lifestyle. Among this group are individuals who suffer from neuropathic pain (NeuP).

The NeuP arises from peripheral or central nervous system damage and is typically unresponsive to routine opioids administered in tolerable doses.<sup>2,3</sup> Like most

Address correspondence and reprint requests to: Simon Thomson, ●●, Pain Clinic, Basildon and Thurrock University Hospitals, Basildon, U.K. E-mail: simon.thomson@btuh.nhs.uk.

Submitted: December 8, 2008; Accepted: January 18, 2009  
DOI: 10.1111/j.1533-2500.2009.00276.x

chronic pain, NeuP is a long-term condition associated with severe disability, psychological illness, financial loss, and social withdrawal.<sup>4-10</sup> Lumbosacral pain with leg radiculopathy, following nerve injury from a prolapsed intervertebral disc, is one of the most frequent causes of NeuP.<sup>11-13</sup> Despite the availability of new drugs, pharmacological treatment of NeuP remains unsatisfactory, with less than half of patients achieving significant benefit.<sup>14-16</sup> Adequate pain relief may not be achieved in up to 30% of patients who have undergone a single back surgery<sup>17</sup> and up to 70% of patients who undergo repeat surgery.<sup>18,19</sup> Many patients become refractory to conventional treatment.<sup>20</sup>

Conventional patient management of neuropathic back and leg pain secondary to disc herniation includes surgery. However, when pain persists and no further surgical target exists, the patient is often described as suffering from failed back surgery syndrome (FBSS), defined as “*persistent or recurrent pain, mainly in the region of the lower back and legs, even after technically, anatomically successful lumbosacral spine surgeries*”.<sup>21</sup> In these patients, NeuP is a principle pain-generating mechanism characterized by predominant leg pain. FBSS is common, affecting around 10% to 40% of patients who have undergone lumbar spinal surgery.<sup>11,18,22</sup>

The NeuP secondary to FBSS presents a considerable challenge to the clinical community. A variety of treating disciplines, each with their own disease concepts and treatment preferences, address the multidimensional needs of patients with refractory neuropathic FBSS. Management can vary considerably from one physician to another, and from one health economy to another. To date no established guidelines describe the best treatment options. However, a consensus has recently begun to emerge.<sup>23</sup> First, the strong NeuP component of FBSS, suggests that success with further corrective surgery is unlikely. Second, recent pharmaceutical developments have improved medical management. Third, the understanding of the complex impact of prolonged pain on both somatosensory and emotional/motivational higher cerebral functioning has spurred multidisciplinary treatment approaches. Nevertheless, a proportion of patients with neuropathic FBSS either do not respond to conventional management or experience subsequent recurring pain.

In a recent review of the literature, it appeared that there is very little demographic data available on FBSS patients: only two reviews were found, which reported only gender and age information.<sup>24,25</sup> The PROCESS (Prospective Randomized Controlled Multicenter Trial

of the Effectiveness of Spinal Cord Stimulation, ISRCTN 77527324) study, designed to investigate the effect of spinal cord stimulation (SCS) on neuropathic FBSS patients, provided an opportunity to review the nature of this condition compared with other chronic pain diseases.<sup>26,27</sup> This article compares the demographic characteristics of the PROCESS study patients, including their treatment history, level of pain and quality of life, with published studies of patients who have other chronic pain conditions, namely osteoarthritis (OA), rheumatoid arthritis (RA), complex regional pain syndrome (CRPS), and fibromyalgia (FM). These conditions are more widely known and, like FBSS, are considered by several pain physicians to be extremely debilitating and life long in duration.

## METHODS

The PROCESS study recruited 100 FBSS patients from 12 centers in Europe, Canada, Australia and Israel between April 2003 and June 2005. The full study inclusion and exclusion criteria are published elsewhere.<sup>28</sup> In summary, eligible patients were at least 18 years of age and had NeuP of radicular origin (radiating in dermatomal segments L4 and/or L5 and/or S1) predominantly in the legs (exceeding back pain), of a mean intensity of at least 50 mm on a visual analogue scale (VAS: 0, no pain to 100 mm, worst possible pain) for at least 6 months after a minimum of one anatomically successful surgery for a herniated disc.

Each center completed a survey outlining their experience in treating pain, the use of neuromodulation techniques (eg, SCS) in the center, and the tools used to diagnose NeuP in the PROCESS study patients.

Baseline demographic and outcome data were collected at entry to the study including sex, age, number of previous surgeries, time since last surgery, employment status, leg pain location, and severity of back and leg pain (VAS scale where 0 = no pain and 100 = worst possible pain). In addition, health-related quality of life was assessed by the Short-Form 36 (SF-36<sup>29</sup>) and EuroQol-5D (EQ-5D<sup>30</sup>), where a high score represents a good quality of life. Level of disability measured by the Oswestry Disability Index (ODI, 0–20: minimal disability to 80–100: bedbound or exaggerating symptoms<sup>31</sup>). Drug and nondrug treatments used for pain relief since the onset of their FBSS related pain were also recorded. Therapies were categorized into seven treatment classes: “antineuropathic” medications (eg, antidepressants, anticonvulsants), physical rehabilitation (including phys-

iotherapy, occupational therapy, and massage), neurostimulation techniques (eg, acupuncture, acupressure, transcutaneous electrical nerve stimulation), psychological rehabilitation, blocks and injections, nonsteroidal anti-inflammatory drugs (NSAIDs) and opioids. The annual cost of drug therapy was calculated using U.K. and Canadian 2005–2006 national figures.<sup>27</sup>

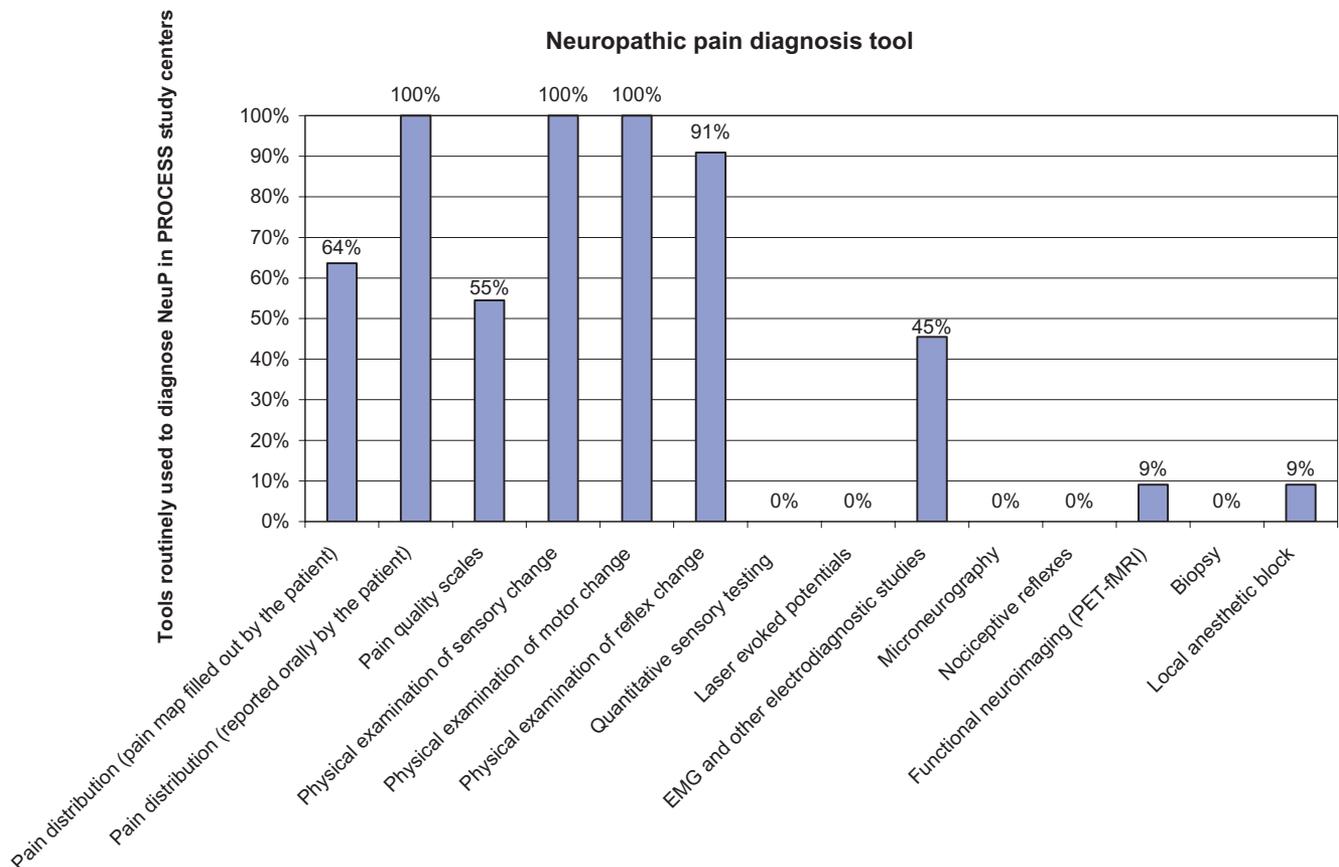
A structured literature search was used to identify comparative demographic, epidemiological (incidence and prevalence) and drug cost data for 4 chronic, painful conditions, ie, RA, OA, FM, and CRPS, in addition to FBSS. The National Library of Medicine PubMed online database was searched for relevant studies (to February 2008). The detailed search strategy is shown in the Appendix. The abstracts and titles retrieved by these searches were screened by a single reviewer and suitable studies selected for inclusion. Studies were included if (1) they were published in the last 10 years and (2) included relevant information on the population of patients in one or more of the 4

chronic pain conditions, not being limited by age or gender. Data was extracted from the original articles by a single reviewer and independently checked by a second reviewer.

## RESULTS

### Pain Assessment Tools Used and Treatments Offered by PROCESS Investigators

The survey was completed for 11 out of 12 centers, which provided information on 99 out of 100 patients. The results revealed that centers were established multidisciplinary pain clinics (average 14 years experience, range 6–26 years), which routinely used a variety of diagnostic tools to diagnose NeuP in the PROCESS study (Figure 1). All were highly experienced in neurostimulation, including SCS (average 14 years experience, range 5–26 years). Despite this, SCS represented only a minority (18%, range 2% to 62%) of the activity of the clinic.



**Figure 1.** Tools routinely used to diagnose neuropathic pain in the PROCESS study centers (data from 11 out of 12 centers for 99 out of 100 patients).

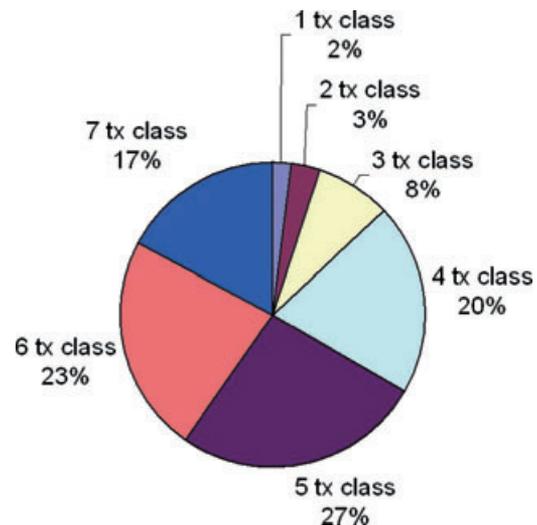
**Table 1. Demographic, Outcome, and Treatment History Data for All Failed Back Surgery Syndrome (FBSS) Patients Included in the PROCESS Study ( $n = 100$ )\***

<b>Demographics</b>	
Number of patients	100
Sex, $n$ (%) male	51 (51%)
Age, mean years (SD)	50.4 (0.4)
Time since last surgery, mean years (SD)	4.7 (4.7)
Number > 1 surgery, $n$ (%)	50 (50%)
Currently in employment, $n$ (%)	22 (22%)
<b>Major source of leg pain, <math>n</math> (%)</b>	
Unilateral	65 (65%)
Bilateral	35 (35%)
Back pain VAS, mean (SD)	49.8 (24.1)
Leg pain VAS, mean (SD)	74.7 (13.5)
<b>Outcomes</b>	
ODI, mean (SD)	56.4 (13.9)
EQ-5D, mean (SD)	0.16 (0.3)
SF-36, mean (SD)	
Physical functioning	23.4 (15.8)
Role-physical	5.1 (17.1)
Bodily pain	16.3 (12.3)
General health	45.7 (23)
Vitality	31.2 (17.5)
Social functioning	35.2 (23.4)
Role-emotional	36.4 (41.8)
Mental health	52.7 (21)
<b>Treatment history</b>	
Pain therapies at time of entering trial, $n$ (%)	
Antineuropathic drugs	
Antidepressants	38 (38%)
Anticonvulsants	38 (38%)
NSAIDs	38 (38%)
Opioids	62 (62%)
Physical rehabilitation	
Massage	2 (2%)
Psychological rehabilitation	3 (3%)
Neurostimulation techniques	
transcutaneous electrical nerve stimulation	8 (8%)
Acupuncture	3 (3%)
Blocks and injections	0 (0%)

\* SD, standard deviation; SF-36, Short Form 36; ODI, Oswestry Disability Index; NSAIDs, nonsteroidal anti-inflammatory drug; PROCESS, Prospective Randomized Controlled Multicenter Trial of the Effectiveness of Spinal Cord Stimulation.

### The FBSS Demographics from PROCESS Trial

Table 1 shows the demographic and outcome data collected for all patients in the PROCESS study. The severity of pain in FBSS patients was on average moderate in the back (mean VAS  $49.8 \pm 24.1$ ), but severe in the legs (mean VAS  $74.7 \pm 13.5$ ). Patients were severely disabled, as indicated by the mean ODI score of  $56.4 \pm 13.9$ , and the mean SF-36 (5.1 to 52.7) and EQ-5D (0.16) scores demonstrated that health-related quality of life was very poor. All patients had tried at least one class of drug or nondrug treatment prior to entry to the study (Figure 2), and 87% had tried 4 or more types of drug and nondrug treatments (eg, physical rehabilitation, neurostimulation techniques, NSAIDs, opioids). The most commonly used drugs at the time of entering the trial were opioids (62% of patients), while



**Figure 2.** Number of treatment (tx) classes (pharmacological and/or nonpharmacological) tried prior to entry in PROCESS study. Therapies were categorized into seven treatment classes: "antineuropathic" medications (eg, antidepressants, anticonvulsants), physical rehabilitation (including physiotherapy, occupational therapy, and massage), neurostimulation techniques (eg, acupuncture, acupressure, transcutaneous electrical nerve stimulation), psychological rehabilitation, blocks and injections, non-steroidal anti-inflammatory drugs, and opioids.

only a few patients were undergoing nondrug therapies such as physical rehabilitation.

Overall, some 50% of patients had undergone more than one surgery, and the mean time since last surgery was relatively long at  $4.7 \pm 4.7$  years. The majority (65%) of patients had unilateral leg pain.

### COMPARISON WITH OTHER CHRONIC PAIN INDICATIONS

Out of 332 abstracts returned by the search strategy, only 27 met the selection criteria. Table 2 compares the demographic data for the FBSS patients in the PROCESS study with those with CRPS, RA, OA, and FM. In the general population, FBSS appears to have a similar prevalence (0.61%; data on file) to RA (0.5%<sup>32</sup>) and a much higher prevalence than CRPS (0.02% to 0.09%<sup>33</sup>). The annual incidence of FBSS (0.033%<sup>34</sup>) is also comparable to that for RA and CRPS.<sup>33,35</sup>

The FBSS patients were of a similar age to those with other conditions,<sup>33,36-39</sup> and the syndrome affected men and women to a similar extent, whereas women are predominantly affected in the other chronic pain indications.<sup>32,33,36-38,40</sup> The severity of back pain in the PROCESS patients was comparable to the body pain experienced in other disorders, but leg pain was sub-

**Table 2. Comparison of the Epidemiology, Demographics, Outcome, and Costs of Failed Back Surgery Syndrome (FBSS) Patients to Those with Other Chronic, Painful Conditions**

	FBSS (PROCESS study)*	CRPS I and II	RA	OA	Fibromyalgia
<b>Epidemiology</b>					
Prevalence, %	0.6 (data on file)	0.02–0.09 <sup>33</sup>	0.5 (CI 0.3–0.9) <sup>32</sup>	10.2 (CI 8.5–11.9) <sup>32</sup>	2–3 <sup>33,56,57</sup>
Annual incidence, %	0.033 <sup>34</sup>	0.005–0.045 <sup>33</sup>	0.02–0.3 <sup>35</sup>	0.24–1.0 <sup>58</sup>	0.7 male <sup>59</sup> 1.1 female <sup>59</sup> 0.6 general <sup>59</sup>
<b>Demographics</b>					
Sex, % female	49	66–86 <sup>33,40</sup>	58–80.4 <sup>37,38</sup>	74 <sup>32</sup>	80–90 <sup>36</sup>
Age, mean (years)	50	39–53 <sup>33</sup>	53–61 <sup>37,38</sup>	50–54 <sup>39</sup>	30–60 <sup>36</sup>
Work disability rate, %	78	31 <sup>48</sup>	50 <sup>35</sup>	Not located	7.3–31 <sup>36,49</sup>
<b>Outcomes</b>					
Severity of pain, (VAS) mean (mm)	Back: 49.8 Leg: 74.7	65–71 <sup>6,46</sup>	34–60 <sup>41,44,45</sup>	32–51 <sup>41,42</sup>	42–67 <sup>41,43</sup>
Disability (ODI) mean	56.4	Not located	27 <sup>45</sup>	Not located	Not located
Health-related quality of life (EQ-5D), mean overall score	0.16	0.42 to 0.47 <sup>60</sup>	0.43 to 0.75 <sup>61</sup>	0.35 <sup>62</sup>	0.33 <sup>63</sup>
Mobility (%) <sup>†</sup>	91.9	62.2 <sup>60</sup>	52.1 <sup>47</sup>	56.3 <sup>47</sup>	66.7 <sup>47</sup>
Self-care (%) <sup>†</sup>	60.6	56.8 <sup>60</sup>	15.6 <sup>47</sup>	14.8 <sup>47</sup>	12.3 <sup>47</sup>
Usual activities (%) <sup>†</sup>	99.0	95.3 <sup>60</sup>	54.3 <sup>47</sup>	51.9 <sup>47</sup>	73.8 <sup>47</sup>
Pain/discomfort (%) <sup>†</sup>	100.0	100.0 <sup>60</sup>	80.6 <sup>47</sup>	76.6 <sup>47</sup>	93.1 <sup>47</sup>
Anxiety/depression (%) <sup>†</sup>	69.7	50.0 <sup>60</sup>	28.5 <sup>47</sup>	26.8 <sup>47</sup>	4.17 <sup>47</sup>
<b>Health-related quality of life (SF-36), mean</b>					
Physical functioning	23.4	Not located	62.3 <sup>47</sup>	62.4 <sup>47</sup>	34.87–33.13 <sup>43</sup>
Role-physical	5.1		49.0 <sup>47</sup>	52.8 <sup>47</sup>	7.90–6.25 <sup>43</sup>
Bodily pain	16.3		58.0 <sup>47</sup>	59.1 <sup>47</sup>	22.49–20.75 <sup>43</sup>
General health	45.7		52.1 <sup>47</sup>	60.0 <sup>47</sup>	34.86–34.42 <sup>43</sup>
Vitality	31.2		52.2 <sup>47</sup>	56.8 <sup>47</sup>	22.63–20.21 <sup>43</sup>
Social functioning	35.2		70.3 <sup>47</sup>	73.2 <sup>47</sup>	37.99–43.23 <sup>43</sup>
Role-emotional	36.4		72.3 <sup>47</sup>	80.5 <sup>47</sup>	35.53–15.28 <sup>43</sup>
Mental health	52.7		69.2 <sup>47</sup>	73.5 <sup>47</sup>	51.53–56.83 <sup>43</sup>
<b>Medication history</b>					
Most common medication used for pain (% of pts)	Opioids (62)	TCA (78) <sup>50a</sup>	NSAIDs (63.6) <sup>32</sup>	NSAIDs (38.2–45.7) <sup>32</sup>	NSAIDs (55.8) <sup>32</sup>
Number of medication classes used per patient, n	4	5.2 <sup>50b</sup>	Not located	Not located	3 <sup>49</sup>
Annual cost of drug treatment	€1,802	€484–€550 <sup>52</sup>	€420–€1,261 <sup>51</sup>	U.S.\$1,184 (€789) <sup>39</sup>	€183 <sup>49</sup>

\* When the same search criteria applied for OA, RA, CRPS, and FM were used for FBSS, only two reviews were found;<sup>24,25</sup> these reported only gender (47% to 50% male) and mean age (50.2–53.5). <sup>†</sup> These are proportion of patients with problems (i.e. moderate or severe) in each of these dimensions of the EQ-5D.

<sup>a</sup> TCA, tricyclic antidepressant; <sup>b</sup> number of treatments; <sup>c</sup> nonsteroidal, anti-inflammatory drugs.

stantially higher.<sup>6,41–46</sup> The disability (ODI) associated with FBSS was greater than that found with RA patients.<sup>45</sup> Not surprisingly, no published ODI scores were found for the other three pain indications, as this questionnaire focuses on back pain.

The proportion of FBSS patients reporting limitations on the individual EQ-5D categories was considerably higher than that of RA, OA, and FM. That the overall EQ-5D associated with FBSS and CRPS were similar indicates the substantive burden on quality of life associated with NeuP. All dimensions of health-related quality of life (SF-36) were lower in the PROCESS patients than OA and RA although similar to those seen in FM patients.<sup>43,47</sup> The work disability rate was substantially higher in the FBSS patients than that found in the other four pain indications.<sup>35,36,48,49</sup> The majority of PROCESS patients used opioid drugs to relieve pain, while antidepressants<sup>50</sup> or NSAIDs<sup>32</sup> are commonly used in the other conditions. In FBSS patients, as in CRPS and FM patients, several classes of medication or types of

treatments were used simultaneously to treat pain.<sup>50,49</sup> The range of average yearly cost of drug therapy for patients suffering from the other conditions varied from €183 to €1,261/patient<sup>39,49,51,52</sup> and was much lower than that of FBSS (€1,802/patient at 2006 costs<sup>27</sup>).

## DISCUSSION

The FBSS is a relatively common chronic pain condition. Patients suffering from NeuP secondary to FBSS seem to experience greater levels of pain, lower quality of life and function than that seen in other more widely recognized chronic pain conditions such as RA, OA, and FM or CRPS. The burden on society is also greater due to higher treatment costs and greater work disability.

The PROCESS study was a randomized, controlled, multicenter trial that evaluated the effects of adding SCS to conventional medical management in patients with FBSS. Baseline demographic data revealed that the patients included in the study had suffered from NeuP for many years and had severe pain (especially in the

legs) that led to substantial disability and a significant reduction in quality of life. Conventional medical treatment was ineffective and all patients had undergone surgery that failed to relieve their pain.

The FBSS appears to affect a relatively large proportion of the general population and has an incidence and prevalence similar to RA, OA, and FM. However, RA, OA, and FM are more widely recognized and treated chronic pain indications. Furthermore, the severity and burden of FBSS is often underestimated with patients experiencing greater levels of pain, increased disability, and lower health-related quality of life compared with the other more recognized chronic pain indications. The majority (78%) of patients with FBSS were unable to work as a result of disability, compared with 50% of RA patients. In addition, most FBSS patients used opioid drugs to relieve pain, while the other diseases use less potent medications that are associated with fewer and less serious side effects.<sup>53</sup> As with the other conditions, which are generally regarded by physicians as difficult to treat, patients with FBSS used multiple drug and nondrug treatments (87% used 4 or more) in a usually futile attempt to reduce the severity of their pain, indicating the refractory nature of the disease.<sup>20</sup> As one might expect, the higher pain burden of FBSS patients results in more treatment, in particular drugs, and therefore a higher cost of pharmacological treatment of FBSS compared with that observed with the other long-term diseases.

This study also found that the PROCESS investigators had many years of experience in treating NeuP, and undertook a range of diagnostic tests to assess FBSS patients (ie, clinical observation of spontaneous symptoms including “burning,” “lancinating,” and “tingling,” evoked symptoms such as sensitivity to hot or cold or brushing and pain felt in an area of innervation where there are also raised thresholds to other nonpainful stimuli; pain descriptors combined with an anatomical distribution as seen on a patient’s pain distribution diagram; altered clinical neurology; imaging and neurophysiological investigations). Perhaps surprisingly none of the centers in the PROCESS study reported use of validated NeuP screening tools (such as LANSS, DN4, and pain DETECT). However, this may simply reflect the fact that many of these tools were either not available or not used in routine clinical practice at the start of the study.<sup>54</sup>

This review has some limitations. We undertook a detailed literature review for demographic data associated with other chronic painful diseases but were not

always able to locate suitable demographic and outcome data. Although our searches were limited to a single bibliographic database, we believe this more likely reflects the general lack of epidemiological and outcome data in the field of pain. The literature review only yielded information on the gender and age of FBSS patients; therefore, all information was derived from a single trial (PROCESS). Although the number of patients in this study ( $n = 100$ ) was quite large for a randomized controlled study in this area, it may not have been a large enough population for a comparative study such as this. Nevertheless, the PROCESS patients seem to be representative of FBSS patients suffering from pain of a predominantly neuropathic origin.<sup>55</sup> Also, as PROCESS patients were referred for SCS they could have been suffering from more refractory and severe pain than the general FBSS population. Despite these limitations, we believe the demographic data shown are indicative of the various conditions.

The results of the PROCESS study indicate that there are substantial potential gains to be made from effective and timely management of FBSS with SCS.<sup>26</sup> At present, SCS represents only a minority of the treatments given to patients with NeuP; such patients may benefit greatly from treatment with SCS,<sup>23</sup> especially if offered at an earlier stage.<sup>19,26,28</sup>

NeuP secondary to FBSS is a relatively common chronic pain condition and may affect a significant proportion of the general population. Neuropathic FBSS patients appear to experience greater levels of pain and disability and lower quality of life compared with that seen in other more widely recognized chronic pain conditions such as RA, OA, and FM. Neuropathic FBSS patients fail to obtain adequate pain relief from surgery and are often refractory to pharmacological therapy. These patients may require alternative and possibly more (cost-) effective treatments, which should be considered earlier in the therapeutic management of neuropathic FBSS.

## ACKNOWLEDGEMENTS

All logistical aspects of the PROCESS study were managed and funded by Medtronic Inc. The authors had complete and independent access to the data. The literature search was performed by David La Framboise and validated by Rod Taylor, PhD, under the direction of the authors. Also, the authors would like to acknowledge the financial and technical support of Medtronic Europe Sàrl in the development of this article.

## REFERENCES

1. Breivik H, Collett B, Ventafridda V, Cohen R, Gallacher D. Survey of chronic pain in Europe: prevalence, impact on daily life, and treatment. *Eur J Pain*. 2006;10:287–333.
2. Hall GC, Carroll D, Parry D, McQuay HJ. Epidemiology and treatment of neuropathic pain: the UK primary care perspective. *Pain*. 2006;122:156–162.
3. Torrance N, Smith BH, Bennett MI, Lee AJ. The epidemiology of chronic pain of predominantly neuropathic origin. Results from a general population survey. *Eur J Pain*. 2006;7:281–289.
4. Frymoyer JW, Cats-Baril WL. An overview of the incidences and costs of low back pain. *Orthop Clin North Am*. 1991;22:263–271.
5. Van Tulder MW, Koes BW, Bouter LM. A cost-of-illness study of back pain in The Netherlands. *Pain*. 1995;62:233–240.
6. Kemler MA, Barendse GAM, van Kleef M, et al. Spinal cord stimulation in patients with chronic reflex sympathetic dystrophy. *NEJM* 2000;343:618–624.
7. Kumar K, Malik S, Demeria D. Treatment of chronic pain with spinal cord stimulation versus alternative therapies: cost-effectiveness analysis. *Neurosurgery*. 2002;51:106–116.
8. Meyer-Rosberg K, Kvarnstrom AK, Kinnman E, Gordh T, Nordfors LO, Kristofferson A. Peripheral neuropathic pain—a multidimensional burden for patients. *Eur J Pain*. 2001;5:379–389.
9. Berger A, Dukes EM, Oster G. Clinical characteristics and economic costs of patients with painful neuropathic disorders. *J Pain*. 2004;5:143–149.
10. McDermott AM, Toelle TR, Rowbotham DJ, Schaefer CP, Dukes EM. The burden of neuropathic pain: results from a cross-sectional survey. *Eur J Pain*. 2006;10:127–135.
11. Wilkinson HA. *The Failed Back Syndrome: Etiology and Therapy*. 2nd ed. Philadelphia, PA: Harper & Row, 1991.
12. North RB, Kidd DH, Campbell JN, Long DM. Dorsal root ganglionectomy for failed back surgery syndrome: a five-year follow-up study. *J Neurosurg*. 1993;39:301–311.
13. Dworkin RH, Backonja M, Rowbotham MC, et al. Advances in neuropathic pain: diagnosis, mechanism and treatment recommendations. *Arch Neurol*. 2003;60:1524–1534.
14. Eisenberg E, McNicol ED, Carr DB. Efficacy and safety of opioid agonists in the treatment of neuropathic pain of nonmalignant origin. Systematic review and meta-analysis of randomized controlled trials. *JAMA*. 2005;293:3043–3052.
15. Finnerup N, Otto M, McQuay HJ, Jensen T, Sindrup SH. Algorithm for neuropathic pain treatment: an evidence based proposal. *Pain*. 2005;118:289–305.
16. Attal N, Cruccu G, Haanpää M, et al. EFNS guidelines on pharmacological treatment of neuropathic pain. *Eur J Neurol*. 2006;13:1153–1169.
17. Javid MJ, Hader EJ. Long-term follow-up review of patients who underwent laminectomy for lumbar stenosis: a prospective study. *J Neurosurg*. 1998;89:1–7.
18. North RB, Campbell J, James CS, et al. Failed back surgery syndrome: 5-year follow-up in 102 patients undergoing repeated operation. *Neurosurgery*. 1991;28:685–691.
19. North RB, Kidd DH, Farrohi F, Piantoadosi SA. Spinal cord stimulation versus repeated lumbosacral spine surgery for chronic pain: a randomized, controlled trial. *Neurosurgery*. 2005;56:98–107.
20. Ohnmeiss DD, Rashbaum RF. Patient satisfaction with spinal cord stimulation for predominant complaints of chronic, intractable low back pain. *The Spine J*. 2001;1:358–363.
21. Leveque JC, Villavicencio AT, Rubin L, Bulsara K, Gorecki JP. Spinal cord stimulation for failed back surgery syndrome. *Neuromodulation* 2001;4:1–9.
22. Stojanovic MP. Stimulation methods for neuropathic pain control. *Curr Pain Headache Rep*. 2001;5:130–137.
23. Cruccu G, Aziz TZ, Garcia-Larrea L, et al. EFNS guidelines on neurostimulation therapy for neuropathic pain. *Eur J Neurol*. 2007;14:952–970.
24. Taylor RS. Spinal cord stimulation in complex regional pain syndrome and refractory neuropathic back and leg pain/failed back surgery syndrome: results of a systematic review and meta-analysis. *J Pain Symptom Manage*. 2006;31(4 Suppl):S13–9.
25. Weiner DK, Kim Y-S, Bonino P, Wang T. Low back pain in older adults: are we utilizing healthcare resources widely? *Pain Med* 2006;7:143–150.
26. Kumar K, Taylor RS, Jacques L, et al. Spinal cord stimulation versus conventional medical management for neuropathic pain: a multicentre randomised controlled trial in patients with failed back surgery syndrome. *Pain*. 2007;132:179–188.
27. Manca A, Kumar K, Taylor RS, et al. Quality of life, resource consumption and costs of spinal cord stimulation versus conventional medical management in neuropathic pain patients with failed back surgery syndrome (PROCESS trial). *Eur J Pain*. 2008;12:1047–1058.
28. Kumar K, North RB, Taylor RS, et al. Spinal cord stimulation vs. conventional medical management: a prospective, randomized, controlled, multicenter study of patients with failed back surgery syndrome (PROCESS study). *Neuromodulation* 2005;8:213–218.
29. McHorney CA, Ware JE Jr, Raczek AE. The MOS 36-item Short-Form Health Survey (SF-36): II. Psychometric and clinical tests of validity in measuring physical and mental health constructs. *Med Care*. 1993;31:247–263.
30. Kind P. The euroqol instrument: an index of health-related quality of life. In: Spilker B, ed. *Quality of Life and*

*Pharmacoeconomics in Clinical Trials*. 2nd ed. Philadelphia, PA: Lippincott-Raven; 1996;191–201.

31. Fairbank JC, Pynsent PB. The Oswestry disability index. *Spine*. 2000;25:2940–2952.

32. Carmona L, Ballina R, Gabriel R, Laffon A. The burden of musculoskeletal diseases in the general population of Spain: results from a national survey. *Ann Rheum Dis*. 2001;60:1040–1045.

33. Marinus J, Van Hilten JJ. Clinical expression profiles of complex regional pain syndrome, fibromyalgia and a-specific repetitive strain injury: more common denominators than pain? *Disabil Rehabil*. 2006;28:351–362.

34. Segal R, Stacey BR, Rudy TE, Baser S, Markham J. Spinal cord stimulation revisited. *Neurol Res* 1998;20:391–396.

35. Woolf AD, Pfleger B. Burden of major musculoskeletal conditions. *Bull World Health Organ*. 2003;81:646–656.

36. Linaker CH, Walker-Bone K, Palmer K, Cooper C. Frequency and impact of regional musculoskeletal disorders. *Baillieres Best Pract Res Clin Rheumatol*. 1999;13:197–215.

37. Brekke M, Hjortdahl P, Kvien TK. Self-efficacy and health status in rheumatoid arthritis: a two-year longitudinal observational study. *Rheumatology (Oxford)*. 2001;40:387–392.

38. Brekke M, Hjortdahl P, Kvien TK. Changes in self-efficacy and health status over 5 years: a longitudinal observational study of 306 patients with rheumatoid arthritis. *Arthritis Rheum*. 2003;49:342–348.

39. Mapel DW, Shainline M, Paez K, Gunter M. Hospital, pharmacy, and outpatient costs for osteoarthritis and chronic back pain. *J Rheumatol*. 2004;31:573–583.

40. Pappagallo M, Rosenberg AD. Epidemiology, pathophysiology, and management of complex regional pain syndrome. *Pain Pract* 2001;1:11–20.

41. Wolfe F, Hawley DJ. Measurement of the quality of life in rheumatic disorders using the EuroQol. *Br J Rheumatol*. 1997;36:786–793.

42. Currey SS, Rao JK, Winfield JB, Callahan LF. Performance of a generic health-related quality of life measure in a clinic population with rheumatic disease. *Arthritis Rheum*. 2003;49:658–664.

43. Marcus DA, Bernstein C, Rudy TE. Fibromyalgia and headache: an epidemiological study supporting migraine as part of the fibromyalgia syndrome. *Clin Rheumatol*. 2005;24:595–601.

44. Wolfe F, Michaud K. Assessment of pain in rheumatoid arthritis: minimal clinically significant difference, predictors, and the effect of anti-tumor necrosis factor therapy. *J Rheumatol*. 2007;34:1674–1683.

45. Rehart S, Pfister A, Kerschbaumer F. Affektionen der Lendenwirbelsäule bei rheumatoider Arthritis. *Orthopäde*. 2007;36:735–738.

46. Kemler MA, de Vet HC, Barendse GA, van den Wildenberg FA, van Kleef M. Effect of spinal cord stimulation

for chronic complex regional pain syndrome Type I: five-year final follow-up of patients in a randomized controlled trial. *J Neurosurg*. 2008;108:292–298.

47. Picavet HSJ, Hoeymans N. Health related quality of life in multiple musculoskeletal diseases: SF-36 and EQ-5D in the DMC3 study. *Ann Rheum Dis*. 2004;63:723–729.

48. Sandroni P, Benrud-Larson LM, McClelland RL, Low PA. Complex regional pain syndrome type I: incidence and prevalence in Olmsted county, a population-based study. *Pain*. 2003;103:199–207.

49. Boonen A, van den Heuvel R, van Tubergen A, et al. Large differences in cost of illness and wellbeing between patients with fibromyalgia, chronic low back pain, or ankylosing spondylitis. *Ann Rheum Dis*. 2005;64:396–402.

50. Allen G, Galer BS, Schwarz L. Epidemiology of complex regional pain syndrome: a retrospective chart review of 134 patients. *Pain*. 1999;80:539–544.

51. Cooper NJ. Economic burden of rheumatoid arthritis: a systematic review. *Rheumatology*. 2000;39:28–33.

52. Kemler MA, Furnée CA. Economic evaluation of spinal cord stimulation for chronic reflex sympathetic dystrophy. *Neurology*. 2002;59:1203–1209.

53. Harden RN, Weinland SR, Remble TA, et al. Medication quantification classes and revised detriment weights by survey of American pain society physicians. *J Pain*. 2005;6:364–371.

54. Bennett MI, Attal N, Backonja MM, et al. Using screening tools to identify neuropathic pain. *Pain*. 2007;127:199–203.

55. Schofferman J, Reynolds J, Herzog R, Covington E, Dreyfuss P, O'Neill C. Failed back surgery: etiology and diagnostic evaluation. *Spine J*. 2003;3:400–403.

56. Gran JT. The epidemiology of chronic generalized musculoskeletal pain. *Best Pract Res Clin Rheumatol*. 2003;17:547–561.

57. Macfarlane GJ. Generalized pain, fibromyalgia and regional pain: an epidemiological view. *Baillieres Best Pract Res Clin Rheumatol*. 1999;13:403–414.

58. Peat G, McCarney R, Croft P. Knee pain and osteoarthritis in older adults: a review of community burden and current use of primary health care. *Ann Rheum Dis*. 2001;60:91–97.

59. McBeth J, Jones K. Epidemiology of chronic musculoskeletal pain. *Best Pract Res Clin Rheumatol*. 2007;21:403–425.

60. Forouzanfar T, Kemler MA, Weber WE, Kessels AG, van Kleef M. Spinal cord stimulation in complex regional pain syndrome: cervical and lumbar devices are comparably effective. *Br J Anaesth*. 2004;92:348–353.

61. Harrison MJ, Davies LM, Bansback NJ, Ingram M, Anis AH, Symmons DP. The validity and responsiveness of generic utility measures in rheumatoid arthritis: a review. *J Rheumatol*. 2008;35:592–602.

62. Xie F, Li SC, Roos EM, et al. Cross-cultural adaptation and validation of Singapore English and Chinese versions of the Knee injury and Osteoarthritis Outcome Score (KOOS) in Asians with knee osteoarthritis in Singapore. *Osteoarthritis Cartilage*. 2006;14:1098–1103.

63. Gusi N, Tomas-Carus P. Cost-utility of an 8-month aquatic training for women with fibromyalgia: a randomized controlled trial. *Arthritis Res Ther*. 2008;10:R24.

## APPENDIX

### Epidemiology search terms

("fibromyalgia"[MeSH Terms]  
OR fibromyalgia [Text Word])  
OR (osteoarthritis [MeSH] OR osteoarthritis [Text  
Word])  
OR (("causalgia"[MeSH Terms]  
OR causalgia[Text Word])  
OR "reflex sympathetic dystrophy"[All Fields]  
OR "complex regional pain syndrome"[All Fields])  
OR ("rheumatoid arthritis"[MeSH Terms]  
OR rheumatoid arthritis [Text Word])  
OR "failed back surgery syndrome" [MeSH Terms]  
OR "failed back surgery syndrome" [Text word]  
AND pain [MeSH]  
AND (epidemiolog\* [MeSH]  
OR epidemiolog\* [Ti]  
OR prevalence [MeSH]  
OR incidence [MeSH])

### Economic impact and quality of life search terms.

AND (("Quality of life"  
OR oswestry OR SF-36)

OR (economic\*  
OR cost  
OR costs  
OR reimbursement\*  
OR "technology assessment\*"  
OR medicare  
OR medicaid  
OR payment\*  
OR price\*  
OR drg  
OR drgs  
OR "diagnosis related group\*"  
OR HCFA  
OR health care financing administration  
OR cms))

Searches were also conducted that combined the term  
"EQ-5D" with the names of four chronic pain  
indications