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Personality Correlates of Spinal Stimulation Surgery Success

Philip Gloninger
Philadelphia College of Osteopathic Medicine, philipgl@pcom.edu

Philadelphia College of Osteopathic Medicine

Department of Psychology

PERSONALITY CORRELATES OF SPINAL STIMULATION SURGERY SUCCESS

By Philip Gloninger

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Dissertation Approval

This is to certify that the thesis presented to us by Philip Glonnger on the 16 day of May, 2013, in partial fulfillment of the requirements for the degree of Doctor of Psychology, has been examined and is acceptable in both scholarship and literary quality.

Committee Members' Signatures:

Don Masey, PsyD, Chairperson

Robert A DiTomasso, PhD, ABPP

David Simons, DO

Robert A DiTomasso, PhD, ABPP, Chair, Department of Psychology

Abstract

The current paper examines personality factors of individuals who received an electrical pain intervention called spinal stimulation surgery. The patients suffered from chronic pain and sought a number of medical interventions before being recommended for this advanced surgical procedure. The research suggests that there are a number of personality factors that are related to success and failure with a number of medical procedures. The research on personality factors and spinal stimulation surgery, particularly research using an updated behavioral health inventory, is limited and inconclusive. The Millon Behavioral Medicine Diagnostic is a valid and reliable behavioral health instrument that provides additional information regarding patient coping styles, psychiatric indicators, health behaviors, and treatment prognostics. The focus of this investigation was to develop a prototypical profile of a chronic pain patient using the Millon Behavioral Medicine Diagnostic as well as to determine what personality variables are related to success with spinal stimulation surgery. Two one-way MANOVAs and other statistical techniques were conducted and revealed no significant differences between success and failure groups on the dependent variables of interest.

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Chapter 1

Statement of the Problem

Neuropathic pain is a chronic, severe form of pain that is less responsive to analgesic drugs and conventional medical management. It cannot be explained by a single disease process or a single location of damage. The degree of disability for individuals suffering from this kind of pain is comparable to that experienced by cancer and heart-failure patients in terms of the impact it has on quality-of-life issues (den Boer et al., 2006). Additionally, an analysis of a major insurance database revealed that the healthcare costs for these patients are three times higher than those of age- and sex-matched individuals without neuropathic pain (Kumar, Malik, & Demeria, 2002). Currently, nonsurgical medical therapy, which includes drug and rehabilitative therapies, is the treatment of choice. In patients with this type of pain, spinal cord stimulation therapy (SCS) has been shown to provide significant pain relief (North, Kidd, Wimberly, & Edwin, 2006). A spinal cord stimulator is an implanted device used to send pulsed electrical signals to the spine to control chronic pain. A recent randomized controlled, multicenter trial demonstrated that SCS surgery provided at least a 50% reduction of pain in 48% of patients, compared to an only 9% reduction of pain in patients receiving conventional medical management (North et al., 2006).

There is a growing body of evidence that certain psychological characteristics are predictive of the outcome of medical procedures involving chronic pain. Psychological testing has been applied to chronic pain patients in many settings and for many purposes: (a) to characterize populations of patients with chronic pain, (b) to evaluate responses to

treatment, and (c) to predict responses to treatment, thereby enhancing the selection of patients (Ruchinskas & O'Grady, 2006).

Approximately 50% of individuals have initial success with temporary SCS surgery (Burchiel et al., 1995). Success with the surgery is considered at least a 50% reduction on self-reported levels of pain (Boswell et al., 2007) However, approximately 10% of individuals who have initial success with the temporary implant either do not go on to have the permanent implant or need to have the permanent implant removed. It is likely that there are certain personality correlates that are indicative of failure with the stimulator. The reasons for eventual failure are most often lack of effectiveness in reducing levels of pain, but they sometimes have more to do with practical issues related to discomfort (either physical or psychological) with the device (den Boer et al., 2006).

Long-term success with the permanent device is defined as a consistent report of a minimum of 50% reduction of pain combined with patient satisfaction (reporting that they would go through the surgery again) (Kumar et al., 2002). The most current research suggests that patients with the lowest levels of anxiety and the highest internal coping ability are more likely to have successful trials and to proceed to permanent implants (Jamison et al., 2008). Furthermore, patients who undergo the surgery and have successful trials are more likely to experience elevated mood and quality of life than are chronic pain patients without the implantable device (Crook, Tunks, & Rideout, 1986).

The research to date does not fully address what patient personality characteristics are indicative of success with the temporary neurostimulator implant. A number of patients who have the surgery before certain behavioral or psychosocial issues are identified and addressed experience a reduction in their chances of success with the

surgery. Additionally, improved psychological screening is likely to increase the number of individuals who will undergo SCS surgery because physicians are more confident in recommending the procedure, thereby making it the treatment of choice rather than the treatment of last resort. Physicians are more confident in the procedure when they believe that a patient is likely to respond favorably, perhaps because of a psychological consideration (Boswell et al., 2007).

Personality inventories are used with increased frequency to identify personality correlates of chronic pain. The Millon Behavioral Medicine Diagnostic (MBMD; Millon, 2001) is a self-report inventory that measures the impact of various psychosocial factors on treatment and adjustment to illness (Cruess, Meagher, Antoni, & Millon, 2007). The MBMD provides detailed information about an individual's psychiatric conditions, coping styles, stress moderators, and treatment outcomes. This instrument is especially helpful in informing healthcare professionals who treat patients experiencing chronic pain. Although the Minnesota Multiphasic Personality Inventory–Second Edition (MMPI–2) is useful in the identification of psychological and personality components of a patient's condition and is widely used, it may not be valid for a medical population because the statistical norms and clinical signs can differ significantly from those of a medical population (Cruess et al., 2007).

The first purpose of the current study was to identify by means of the MBMD psychological characteristics of individuals who are successful with the temporary implant and go on to have the permanent surgery. Specifically, the current study sought to determine what personality factors predict success with the temporary implant and to identify characteristics of individuals who have the permanent implant. An additional

component of the current study was to determine what personality profiles, as measured by the MBMD, are salient in patients who are screened for a spinal cord stimulator evaluation, regardless of their success with the stimulator.

Chapter 2

Introduction

Nearly 70 million Americans each year experience some form of chronic pain (Tunks, Crook, & Weir, 2008). Traditional pain management, such as pharmacological and surgical interventions, provides only modest relief. Research related to psychosocial and personality factors related to pain has been conducted to explore the reasons for this lack of success (Tunks et al., 2008). A major challenge for medical and healthcare professionals is that of addressing patients' psychological issues related to chronic pain. For example, patients with personality disorders may alienate themselves from treatment providers because of erratic behavior, individuals with chronic untreated depression tend to take a passive role in their medical treatment, and extremely anxious patients are likely to be highly sensitive to even minor pain (Mok & Lee, 2006).

Chronic pain is defined as pain that lasts more than 3 to 6 months, and population studies suggest that between 11% and 30% of individuals experience chronic pain at some point in their lives (Whal et al., 2009). The economic burden of chronic pain is greater than that of cancer, heart disease, and diabetes combined (Whal et al., 2009). In 1998, the National Institutes of Health (NIH) noted that the economic cost of chronic pain is over $100 billion and is likely to steadily rise (NIH, 1998). Instead of receiving effective relief from pain, patients are often in an endless cycle of multiple healthcare providers, repeated tests, and inadequate treatments. Chronic pain patients are likely to experience a variety of mental health issues, such as depression and anxiety, in response (NIH, 1998).

Chronic low back pain (CLBP) is a complex and difficult-to-treat form of pain that takes a financial and emotional toll on the patient (Weiner, Sakamoto, Perara, & Breuer, 2006). CLBP is associated with a host of adverse consequences, including anxiety, depression, traumatic stress, insomnia, and increased use of healthcare resources (Weiner et al., 2006). One in three older adults experiences CLBP (Moldovan, Onac, Vantu, Szentagotai, & Onac, 2009). Additionally, advanced medical imaging techniques such as MRI are often unable to detect CLBP, thereby leaving many patients with unclear diagnoses. Unclear detection partially explains the 5% to 40% low back surgery failure among CLBP patients (Weiner et al., 2006).

Pain personality connection.

Research examining pain personalities using the MMPI–2 has helped to classify patients who may respond favorably to medical treatments. Costello, Hulsey, Schoenfeld, and Ramamurthy (1987) empirically derived four separate personality typologies of chronic pain patients from existing research. Using cluster analysis, the researchers organized chronic pain patients into unique categories, each one a different letter in the word *pain.*

Type P includes elevations on a majority of the clinical scales of the MMPI–2 and appears to be the most pathological of the profiles. Individuals with such elevations usually report that they are in extreme pain, and they display a high degree of distress and emotional instability. Also, type P individuals are likely to report a definite reason that they experience pain. Although they seek healthcare at the highest rate, they are the least likely to improve after treatment. In contrast to type P individuals, type N individuals

usually have a normal MMPI–2 profile. They do not report especially high levels of pain, and they demonstrate a high degree of emotional stability. Not surprisingly, this type of individual responds most favorably to treatment. Type I is the profile that is the most physically unwell because they have the most restriction in their mobility, the highest number of surgeries, the most hospitalizations, and the least physical improvements in response to treatments. Additionally, Type I patients tend to score the highest on the hypochondriasis scale. Although they are the most impaired, they attempt to adapt to their limitations (Costello et al., 1987). Finally, the type A profile demonstrates a lack of empirical correlates, although it resembles a profile called the conversion V. The conversion V occurs when a patient has elevations on scales 1 and 3, but not on scale 2. This profile arises from an endorsement of somatic symptoms and a tendency to deny symptoms of anxiety and depression (Schwarz & Krupp, 1971). These patients tend to develop physical symptoms in the face of psychological stress.

Depression and chronic pain.

Despite an attempt to discover a general "pain-prone personality," there is little empirical support for such an entity (Gatchel, 1991). Recent empirical work has focused on identifying certain personality characteristics, such as depression, that predispose people to experiencing chronic pain. Chronic pain and depression are inextricably linked; the burden of living in a constant state of pain likely takes an emotional and psychological toll on an individual. Individuals with chronic pain are at least four times more likely than nonpain patients to have a major depressive disorder (Tunks et al., 2008). Researchers conducted a telephone survey in which 17% of the 18,000

participants had at least one chronic pain condition, and 16% met criteria for depression (Crook, Tunks & Rideout, 1986). Individuals with chronic pain were almost twice as likely to report symptoms of depression than nondepressed patients. Additionally, individuals with painful medical conditions were significantly more likely to be depressed than were individuals with nonpainful medical conditions (Tunks et al., 2008).

Another study of patients in an urban pain clinic found that there were more than twice as many depressed and anxious patients than nondepressed patients, and anxious patients had increased expenses and poorer prognoses (Becker et al., 1997). The patients in this study also suffered from poor psychological and social well-being and had diminished health-related quality of life. Additionally, these patients were significantly less likely to report psychological symptoms than physical symptoms.

Depression is clearly linked to poor outcomes in medical procedures (Weaver et al., 2005). Depression can act as a barrier to a patient's ability to adapt to lifestyle changes and to recover from invasive surgeries (Weaver et al., 2005). Although research supports a strong link between depression and pain (Romano & Turner, 1985), the nature of this relationship is unclear (Turk & Rudy, 1988). Some patients develop depression before developing pain. It is unclear whether depression is a reaction to coping with pain or a predisposition to developing chronic pain.

A model developed by Gatchel (1997) discusses a three-stage developmental course of chronic pain. During the first stage, emotional reactions, such as fear and anxiety in response to the perception of pain, are predominant. If the pain continues into an advanced acute stage (2 to 4 months), then a wider range of psychological problems, such as depression and somatization, occurs as a result. The intensity and severity of the

issues depend upon an individual's preexisting personality characteristics. For example, an individual with a predisposition for depression is more likely to display severe depressive symptomatology after experiencing long-term pain than a nondepressed individual. Within this model, it is assumed that patients have existing personality traits that are exacerbated by the stress of trying to cope with chronic pain (Gatchel, 1997). This relationship between physical health conditions and depression has been clearly documented (Barret, Rose, & Klerman, 1979). The final stage of this model occurs when an individual's psychological issues lead him or her to adopt the "sick role." Adopting such a role becomes a strong reinforcer and keeps the patient in a negative cycle of wanting to get better, but maintaining a passive or dependent role in relationship to his or her chronic pain (Barret et al., 1979).

Exploring the relationship between personality and pain.

Affective, cognitive, and behavioral patterns contribute to a patient's experience and maintenance of his or her pain. Emotional components, such as depression and anxiety, are strongly associated with an increased perception of pain intensity. An individual experiencing negative emotion as a result of pain is likely to engage in self-defeating cognitions, such as helplessness and catastrophizing, and cognitions reinforce negative behavioral patterns (Strategier, Chwalisz, Altmair, Russell, & Thomas, 1997). The patient's behavioral patterns, such as inactivity and seeking support from spouses, may hinder functioning (Strategier et al., 1997).

There are a number of hypotheses related to the interface of pain and personality issues. One idea is that personality issues are a likely antecedent and potentially

complicating factor for an individual with chronic pain (Elliot, Jackson, Layfield, & Kendall, 1996). However, Borchgrevink, Stiles, Borchgrevink, and Lereim (1997) studied whiplash patients who had long recovery periods and found that MBMD profiles were in nonpathological ranges at intake. This finding is considered surprising because a number of studies demonstrate that patients with chronic pain often have elevated psychological scales, thereby indicating premorbid pathology. They interpreted this finding as evidence against the role of personality factors in the development of chronic pain and as indicative of a more indirect etiology.

The ramifications of dealing with a long-term illness often lead to personality and psychological problems (Naber, Weinberger, Bullinger, Polsby, & Chase, 1988). Additionally, individuals with personality disorders tend to have reduced social and emotional resources and, as a result, are vulnerable to the difficulties posed by chronic pain issues. These patients may be more likely than average to populate pain clinics (Goossens & Evers, 1997).

Patients with chronic pain have relatively elevated scores on specific measures of personality. Specifically, chronic pain patients tend to be more pessimistic, emotionally vulnerable, and likely to somaticize feelings of anxiety and depression than nonmedical populations (Gatchel, 1997). Additionally, chronic pain patients are more likely to endorse items related to introversion, sensitivity, and emotional vulnerability than patients without chronic pain (Gatchel, Deckel, Wienberg, & Smith, 1985). Typical clinical patterns in the chronic pain population include patients who are overly sensitive and emotional, keep problems to themselves, experience a high degree of anxiety, and have a pessimistic view of the future (Gatchel et al., 1985).

Treatments for chronic pain.

Psychosocial interventions for chronic pain are often used primarily or in conjunction with medical treatments to treat emotional distress, cognitive and personality factors, drug dependency concerns, and social consequences of chronic pain (Mok & Lee, 2004). In addressing emotional distress, treating comorbid depression and anxiety with psychotherapy is common practice. For generalized concerns, clinicians use behavioral treatments, such as meditation, sleep hygiene, biofeedback, and progressive relaxation. Additionally, therapeutic exercise and lifestyle management are often helpful in alleviating the intensity of reported pain (Dixon, Keefe, & Scorpio, 2007).

The medical interventions for chronic pain encompass three main components: physical, chemical, and electrical. The physical component incorporates all modalities that may directly affect the musculoskeletal system (Disorbio, Bruns, & Barolat, 2006). For example, chiropractic manipulations, physical therapy, occupational therapy, massage, exercise, and traction to list only a few are physical components that help individuals with chronic pain. These targeted interventions are aimed at correcting physical imbalances produced by the pain condition. Such interventions are crucial early in the treatment of pain conditions because they may correct the root cause of the pain (Bruns & Disorbio, 2009). In cases of chronic pain, physical interventions are likely to prevent increased physical damage from disuse or atrophy (Disorbio et al., 2006).

Chemical interventions are aimed at restoring biochemical imbalances that are thought to increase the intensity of pain. Oral administration of narcotics, anti-inflammatory medications, and antidepressants, topical analgesic medications that enter the bloodstream through the skin, and intraspinal administration of narcotic medication

encompass the repertoire of chemical interventions. Intraspinal administrations are considered an extreme measure because of the high likelihood of serious complications and side effects. The large number of drugs available, in conjunction with the variety of administration protocols, suggests that chemical interventions are suboptimal (Davis, 1999).

The electrical component of the treatment for chronic pain acts on the premise that all pain reactions in the body are transferred via electrical impulses within the central nervous system. Through this lens, chronic pain is conceptualized as an abnormal electrical signal. By applying a superfluous stimulus to the nervous system, the pain signal is potentially rewired and experienced as less painful. The most basic form of neurostimulation is called transcutaneous electrical stimulation. This is particularly effective for localized pain (Davis, 1999).

Neurostimulators can now be surgically implanted on the spinal cord. The device is typically implanted in a pocket under the skin and then connected with wires to specific electrodes. This is considered the most effective treatment for neuropathic pain and permanent nerve injury (Kumar et al., 2002).

Spinal cord stimulation.

The technology behind electrical interventions has improved considerably over the past 20 years (Holsheimer, 1997). Spinal cord stimulation (SCS) therapy is an increasingly popular option for patients with chronic neuropathic pain. During the procedure, a surgical device is implanted into the patient's back, and it effectively blocks some of the pain signal from transmitting up the spinal cord to the brain (Alo &

Holsheimer, 2002). Although the procedure was introduced in 1967, significant improvements have been made in terms of the surgical and hardware component of the device, thereby making it a practical option for patients experiencing chronic pain (Ackroyd, Dudley, Graves, McVey, & Horton, 2005).

Spinal cord stimulation therapy has been used to effectively treat chronic low back pain after basic treatments had failed (Kumar et al., 2002). Additionally, research has demonstrated that treating patients with SCS may be cheaper than conventional medical treatments (Kumar et al., 2002). Kumar and colleagues studied 104 patients with chronic lower back pain, 60% of whom had the device. Those with and without the device were evaluated over a 5-year period. The results demonstrated that the annual medical costs for the spinal implant group were $29,000 versus $38,000 for the nonimplanted group. The higher costs in the nonstimulator group were accounted for by medications, emergency center visits, x-rays, and ongoing physician visits. Despite the initial high costs of implanting the device, the long-term costs are significantly diminished (Kumar et al., 2002).

Recent technical improvements in the hardware, particularly electrodes inserted into the epidural space and supporting electronic devices, have led to positive clinical outcomes (Holsheimer, 1997). Current research findings indicate that even when patient pain issues are diffuse and cannot be pinpointed, accurately implanted electrodes offer optimal pain coverage over large areas (Holsheimer, 1997).

Patients receive either of two kinds of subcutaneous implants, a complete pulse generator module with its own battery or a radio frequency receiver. The former is charged externally via a wireless power charger that does not need to be replaced

surgically when it loses charge. The radio frequency receiver is externally driven by a transmitter from which it gets its power and pulses. It also has a battery, which can easily be replaced (Bell, Kidd, & North, 1997).

The process of SCS surgery is different from many other surgical procedures in that a patient has two opportunities to accept or reject a treatment. After an initial consultation with a physician, patients receive a psychological evaluation and may be cleared for a temporary trial implantation of the stimulator. During this time, patients are able to test the device, and if it is helpful in reducing at least 50% of their pain, they often opt to receive the permanent implant (Block, Ohnmeiss, Guyer, Rashbaum, & Hochschuler, 2001).

Shealey, Taslitz, Morimer, and Becker (1967) developed spinal cord stimulation therapy based on Melzak and Wall's gate control theory of pain. According to the gate control theory, a gating mechanism exists within the dorsal horn of the spinal column that either enhances or inhibits the perception of pain, depending upon the level of stimulation. Furthermore, peripheral stimuli interact with cortical variables, for example mood and anxiety, in the perception of pain. In this model, pain is considered from a biopsychosocial perspective in that both physical and affective components are important in the development and perception of pain. Psychological variables, such as past experiences, attention, and other cognitive activities, play a major role in the perception and experience of pain. This model helps to explain why pain experiences differ from individual to individual. It also accounts for the fact that a large percentage of individuals either do not benefit from SCS procedure or benefit only for a time (Burchiel

et al., 1995). For example, the overall efficacy of spinal cord stimulation ranges from 25% to 90%, depending on the subject sample (Burchiel et al., 1995).

A number of factors have contributed to differences in outcomes, including the fact that SCS has traditionally been used to treat a diverse group of pain conditions; only recently has SCS been proven to work for chronic, nonmalignant pain of a neuropathic origin (Kim, Yoon, & Chung, 1996). Radicular pain, or inflammatory pain, tends to respond more favorably than axial, or structural, low back pain. Radicular pain is described as a shooting pain that is not fully localized and moves from one area to the next. This type of pain is generally considered a result of central nervous system dysfunction, as opposed to structural or nerve damage (Kim et al., 1996). Additionally, the consideration of psychological components in the etiology and maintenance of chronic pain has only recently been considered. Major personality disorders, secondary gain, malingering, and drug abuse problems are discovered in thorough evaluations, which improve the success rate of spinal stimulation surgery in various pain populations (Burchiel et al., 1995). Consistent criteria for success with SCS vary widely among studies. Some measures define success in terms of subjective ratings, such as self-report of pain and quality of life improvements, whereas other measures include objective scales, such as changes in work status, medication usage, or medical utilization (Kumar et al., 2004).

Personality variables related to medical procedures.

It is likely that psychosocial factors are directly related to patient outcomes following serious medical procedures (Beltrutti et al., 2004). Additionally, personality variables play an important role in the development and maintenance of a number of health conditions other than chronic pain. For example, Cruess, Meagher, Antoni, and Millon (2007) investigated the problem of treatment adherence in various chronic medical illnesses, such as HIV. The authors found that a number of patients do not adhere to the highly active anti-retroviral therapy (HAART) that is prescribed for the treatment of HIV because of psychological and behavioral issues, such as negative affect, low social support, active drug use, avoidance coping, and high levels of perceived stress. Additionally, the researchers used the Millon Behavioral Medicine Diagnostic (MBMD) and found that overall adherence to the HAART program was associated with low scores on the depression, cognitive dysfunction, emotional lability, maladaptive coping, and medication abuse scales. After controlling for demographics, disease severity, and health behavior variables, the researchers used the MBMD to correctly predict whether 77% of participants were in the medically adherent group or nonadherent group.

A study using the Millon Behavioral Health Index (MBHI), an earlier version of the MBMD, reported that certain scales were directly related to improved pain management indicators among male and female patients completing a 20-day outpatient program for chronic pain (Wilcoxson, Zook, & Zarski, 1988). The MBHI scales for recent stress, chronic tension, inhibited style, pain treatment responsivity, and premorbid pessimism successfully predicted improvements in time sitting, grip strength, number of stairs climbed, time on a treadmill, and treadmill speed (Wilcoxson et al., 1988).

Additionally, using a composite score reflecting global treatment improvements, the researchers used the MBHI scales and demographic information to correctly predict 97% of outcomes (Wilcoxson et al., 1988).

The MBHI was also able to predict level of tolerance of a hyperthermia treatment for cancer. The treatment itself is relatively painful; however, it enhances the effectiveness of both chemotherapy and radiation. Patients who scored below the median on the pain treatment response and future despair scales were more capable of tolerating the hyperthermia than those who scored above the median on these scales. Additionally, patients with scores above a clinically significant score of 75 on the sensitive, cooperative, and forceful scales tolerated pain better. Overall, the authors concluded that less sensitive and emotionally reactive patients and more cooperative, assertive and hopeful patients were more tolerant of the treatment (Rozensky, Honor, Tovian, Herz, & Holland, 1985).

The MBHI was also used in research that successfully predicted the recovery of physical functioning in patients with low back pain. Low scores, in the nonsignificant range, on the introversive and emotional vulnerability scales predicted improved physical outcome in these patients. Furthermore, sensitive style, recent stress, emotional vulnerability, and gastrointestinal susceptibility scales discriminated between patients who had dropped out of the pain management program and those who had completed it (Gatchel, Mayer, Capra, Diamond, & Barnett, 1986).

A subsequent study evaluated different psychological and demographic predictors of low back pain treatment success. A group of chronic low back pain patients completed the MMPI–2 and the MBHI before engaging in a functional restoration program

consisting of physical therapy and other conventional medical treatments (Murphy, Sperr, & Sperr, 1986). Individuals who were stubborn and distrustful as well as pessimistic at the outset, as measured by the MBHI, were more likely to not succeed over the course of treatment (Murphy et al., 1986). Additionally, patients with initial increased depression scores were significantly more likely to fail over the course of treatment (Barnes, Smith, Gatchel, & Mayer, 1988).

MMPI–2 and spinal surgery outcomes.

A variety of behavioral health scales are used to identify characteristics of patients who are likely to either respond favorably or not respond favorably to medical procedures. To date, the majority of the research conducted in the area of spinal surgery outcomes related to personality variables uses the MMPI–2. Several studies have demonstrated that psychological factors are important in predicting outcomes following elective spine surgery. Block et al. (2001) evaluated the effectiveness of a presurgical personality instrument in predicting successful outcomes after spine surgery. Two hundred four chronic low back pain patients were referred for a presurgical evaluation, and all subjects completed an MMPI–2 to measure their level of psychological functioning in conjunction with the severity of their medical condition. The results demonstrated that patients who had poorer outcomes following surgery had elevated scores on the MMPI–2 scales measuring hypochondriasis, depression, and hysteria. Only clinically significant scaled scores ($T > 65$) were considered in this study. Overall, the study found that higher levels of psychological issues, including depression and anxiety, as measured by the MMPI–2, were linked to poor surgical outcomes (Block et al., 2001).

An additional finding was that depression and anxiety were stronger predictors of surgical outcome than all medically related factors, such as chronicity of pain and number of treatments tried before surgery.

The subjects in the previous study were referred by an orthopedic surgeon to receive psychosocial screening. The screening included identification of medical and psychological risk factors based on the MMPI–2. After low back surgery, patients were contacted within 6 months. By this time, the researchers predicted a surgical prognosis based on medical and psychological risk factors. The outcome measures included a change in patients' subjective report of pain, medication use, and objective functional improvements, such as returning to work. The findings of this study demonstrate that psychological and medical risk factors can be identified and quantified and that they are able to correctly classify between 82% and 84% of patients into categories of either success or failure with surgery (Block et al., 2001).

A more recent meta-analysis of relevant medical and psychological predictor variables for low back surgeries was conducted by den Boer et al. (2006). All 11 studies included in the meta-analysis were prospective studies that measured the effectiveness of various preoperative variables, including psychological issues, in predicting the outcome of low back surgeries. The psychological variables that were measured included depression, anxiety, somatization, coping strategies, life events, and social support. Overall, higher levels of anxiety ($T > 65$) and somatization and a passive avoidant coping strategy consistently predicted a poor outcome following spine surgery (den Boer et al., 2006).

Olson, Marshall, Anderson, Burchiel, and Villanueva (1998) studied a sample of 43 chronic pain patients referred to an inpatient SCS temporary electrode trial. Patients completed a full psychological evaluation, including an MMPI–2 and a Beck Depression Inventory, and were divided retrospectively into either a success or failure group. Success was defined as at least a 50% reduction in pain levels, as measured by self-report. Patients who had serious mental illnesses or were actively abusing substances were excluded from the study. The results indicate that patients with higher levels of depression ($T > 65$) are significantly more likely to fail with the temporary implant than individuals with lower levels of depression (Olson, Marshall, Anderson, Burchiel, & Villanueva, 1998). These results are consistent with previous research findings that identified a correlation between depression and treatment failure 3 months after SCS surgery (Burchiel et al., 1995).

Early studies suggest that personality variables account for a significant proportion of the variance in SCS surgery outcomes. Daniel, Long, Hutcherson, and Hunter (1985) examined success with SCS surgery in relationship to psychological predictor variables. The MMPI–2 results for patients who failed to experience adequate pain relief with the surgery indicated personality disorders, drug dependence, unstable personal relationships, and poor vocational adjustment. According to these researchers, these factors maintain chronic pain and preclude patients from participating in SCS surgery.

The results of a study by Ruchinskas and O'Grady (2000) utilizing the MMPI–2 demonstrated that personality variables played a significant role in outcome success with SCS surgery. Patients who received the permanent implant were more likely to have

lower defensiveness and conversion hysteria scores than individuals who did not receive the implant. Additionally, patients who were more expressive of their physical complaints were more likely to possess better coping skills and to reject the procedure. These findings are somewhat paradoxical because most of the research confirms that patients who are overly expressive of their physical complaints are more likely to fail with the surgery because of their elevated hypochondriasis (Ruchinskas & O'Grady, 2000).

Normative data for the MMPI–2.

The MMPI–2 made major changes in the norm group used from that used in the previous MMPI. The contemporary normative sample was developed in order to match the 1980 census data (Butcher, Dahlstrom, Graham, Tellegen, & Kaemmer, 1989). This was largely accomplished, although the normative sample tended to be biased toward higher socioeconomic levels and educational status compared to the general U.S. population. Also, Hispanic and Asian subpopulations are underrepresented. Researchers and clinicians should take these issues into account when interpreting clinical profiles generated by chronic pain patients.

The normative revision included a new sample of psychiatric patients who were used as a comparison group. This new sample was used to provide information about the performance of the MMPI–2 with a clinical sample, as well as to help refine the new content scales (Keller & Butcher, 1991). Relative to using the MMPI–2 with chronic pain patients, this new psychiatric comparison group should assist in the identification of psychopathology and personality characteristics.

The norms for the MMPI–2 are based upon a large national sample. Scores from this sample provide the raw score distributions used to develop T scores for each scale. The original MMPI involved the conversion of scaled scores to standard scores using a linear transformation with a mean of 50 and a standard deviation of 10 relative to the original normative sample. Because of a number of problems in using linear T score transformations, "uniform" T scores transformations were used on the MMPI–2. The new uniform T scores resulted in somewhat lower profile elevations than those resulting from linear transformations. It is likely that this finding affects the interpretive strategy based upon scale elevations (Butcher & Keller, 1991). For example, substantially fewer pain patients are likely to be classified as being psychologically distressed with the MMPI–2 than with the MMPI (Butcher et al., 1989). This issue has been addressed by the shift in the level of a critical scale elevations, a T score of 70 on the MMPI and a T score of 65 on the MMPI–2 (Keller & Butcher, 1991). A comprehensive study of the use of the MMPI–2 with chronic pain patients has substantiated the validity of this lower critical T score level on the MMPI–2 (Keller & Butcher, 1991).

Millon Behavioral Medicine Diagnostic.

Although the MMPI–2 is a relatively outdated behavioral medicine tool, the majority of research conducted in the area of chronic pain management utilizes this assessment instrument (Bush, 2009). The Millon Behavioral Medicine Diagnostic (MBMD) is a self-report inventory that measures the impact of various psychosocial factors that affect a patient's medical treatment and adjustment to his or her illness. The

MBMD provides detailed information about psychiatric conditions, coping styles, stress moderators, and predicted treatment outcomes. This instrument is especially helpful to healthcare professionals who treat patients experiencing chronic pain. Although the MMPI–2 is useful in identifying psychological and personality components of a patient's condition, it may not be valid for a medical population because the statistical norms and clinical signs can differ significantly from those of patients with medical issues (Cruess et al., 2007).

The normative data for the MBMD were gathered from a medical population and include data from patients treated for cancer, diabetes, and cardiac and neurological conditions, as well as from patients with chronic pain (Wise & Streiner, 2010). This improves the utility of the MBMD for medical populations and makes it a more informative and useful tool for a medical treatment team (Wise & Streiner, 2010).

The norms for the MMPI–2 are based on a sample of 2,600 individuals (Butcher et al., 1989). The gender distribution was 1,138 males and 1,462 females. These individuals came from the states of California, Minnesota, North Carolina, Ohio, Pennsylvania, Virginia, and Washington. Butcher et al. compared the demographic characteristics of this sample with data from the 1980 U.S. census. In short, participants were adults, ages 18 and older, from a variety of socioeconomic, ethnic, and educational backgrounds. The following seven demographics were represented within the normative sample: age, race, marital status, occupation, education, ethnic identification, and gender. Except for age and education, all variables are categorical in nature. Raw scores from this sample were used to develop T scores for each scale of the MMPI–2.

The MMPI–2 has been used to classify and compare chronic pain patients with the general population. Costello et al. (1987) developed a normative pain group by using a metaclustering technique and identified four types of chronic pain patients. Their system is called PAIN, and each letter represents a different type of pain patient. *P* describes a generally depressed patient who has multiple scale elevations, *A* identifies a conversion V profile, in which psychological symptoms are significantly minimized. *I* represents the neurotic triad, in which the first three scales are elevated, and *N* is a within normal limits profile.

Many researchers have expanded on Costello et al. (1987) since typologies were introduced. Keller and Butcher (1991) were able to identify a three-cluster typology across multiple groups of chronic pain patients (general elevation, neurotic triad, and within normal limits). These patients consistently fit into one of these three groups. Riley, Robinson, Geisser, Wittmer, and Smith (1993) attempted to compare the three-cluster and four-cluster solutions for patients with chronic low back pain. They concluded that the four-cluster solution was more appropriate. They also found significant differences across these subtypes, depending on both the number of previous back surgeries and preinjury psychiatric treatment.

Riley, Robinson, Geisser, and Wittmer (1995) investigated whether the MMPI–2 cluster profiles described previously could predict surgical outcomes of patients undergoing spine surgery. The study found that patients from the within normal limits subgroup or neurotic triad subgroup were significantly more satisfied after surgery than were patients from the depressed or conversion V subgroups.

Before the MBMD, an instrument that can identify the full spectrum of psychosocial risk factors that impede medical outcomes was lacking (Antoni, Millon, & Millon, 1997). Further, the MBMD identifies these factors in an efficient, reliable, and valid way, with the potential to maximize medical patient health outcomes. The theoretical framework of the MBMD includes the domains of psychiatric indicators, coping styles, stress moderators, and negative health habits. Each domain is represented by a scale. The scales may individually and/or additively relate to health maintenance behaviors, such as risk factors and adherence to medical protocols, as well as to factors that may limit medical outcomes, such as substance abuse and smoking. Additionally, and most importantly for the current study, the theoretical framework of the MBMD hypothesizes that the aforementioned psychosocial factors are related to patient response to major medical interventions, including recovery time and posttreatment compliance with medical regimens. The MBMD was created for the purpose of identifying psychosocial risk factors of serious medical procedures (Antoni et al., 1997).

Improvements in the MBMD.

The MBMD was created to replace the outdated MBHI because the MBMD takes personality testing in a number of more advanced and clinically different directions. For example, the MBMD examines several important psychosocial characteristics that the MBHI does not, including the presence of psychiatric indicators such as anxiety and emotional lability, information on coping styles, religious and spiritual resources, and important lifestyle factors, such as substance abuse, eating habits, and exercise routines. The psychiatric indicators and the stress moderator scales appear to be the most reliable

and valid scales of the instrument, with reliability coefficients of .75 and .85, respectively (Atkinson, 2005). Additionally, two of the prognostic scales, interventional fragility and utilization excess, demonstrated acceptable reliability estimates of .80 and .76, respectively. Test−retest reliability estimates were strong, ranging from .71 to .92 for the 32 clinical scales. Overall, researchers have found that these scores remain consistent over time, although there is significant crossover between scales in terms of the constructs that they measure

Additionally, the MBMD offers important information on a patient's style of communication, such as the importance he or she places on details and social desirability. The MBMD offers additional information about a patient's health habits, such as alcohol and tobacco use, which may affect physical illnesses. Finally, the completed MBMD contains detailed information about patients' adherence to medical regimens and their overall affective reactions to medical procedures. Such information is invaluable to medical decision making and clinical outcomes (Wise & Streiner, 2010).

Early and current research using the MBMD.

Early research with the MBMD focused on the predictive validity of the treatment prognostics scales, which include interventional fragility, medication abuse, information discomfort, service utilization, problematic compliance, psychiatric referral, and management risk. In one study by Millon, Antoni, Millon, and Davis (1997), 99 patients were rated on each of the treatment prognostic scales by psychologists in various medical settings, including a diabetes research institute, a comprehensive cancer center, and an organ transplant unit. The MBMD scale scores of patients were significantly correlated

with the staff rating scale scores that assess the same treatment-related domains. This finding demonstrates a high degree of construct validity of the treatment prognostic scales and adds support for the predictive validity of the MBMD.

The majority of research relating the MBMD to medical outcomes examines heart disease, diabetes, and cancer (Millon et al., 1997). Millon et al. (1997) compared people with these three major medical illnesses to healthy patients in terms of their MBMD profile scores. Statistically significant differences were noted between healthy and diseased patients on a number of scales, including guardedness, introversive, inhibited, nonconforming, forceful, respectful, oppositional, functional deficits, social isolation, medication abuse, utilization excesses, problematic compliance, adjustment difficulties, and psychiatric referral. Specifically, healthy patients tended to score lower on the scales than did patients with major medical illnesses.

A number of studies of HIV-infected individuals sought to establish criterion validity for several MBMD scales by comparing their correlations with measures that are well-established indices of coping strategies, optimism, social support, and mood disturbances (Carver et al., 1998). Forty patients with HIV completed the MBMD and the Neuroticism, Extraversion, Openness Personality Inventory. In terms of specific coping strategies for this population, the MBMD inhibited, dejected, and denigrated scores were associated with behavior disengagement (giving up) and inversely correlated with adaptive strategies, such as acceptance and optimism. The MBMD treatment prognostic scores, specifically, interventional fragility, were associated with higher levels of depression. These scores reflect some of the emotional issues and poor coping strategies that are directly related to these patients' illness. Patients who score high on

pain sensitivity tend to have more complaints about medication side effects and have more difficulty in coping with invasive medical procedures. Patients with elevations on the social isolation scale are likely to avoid or disengage from their illness and are likely to experience greater challenges in facing their illness (Carver et al., 1998).

MBMD and spinal surgeries.

Only within the last 10 years has there been research examining behavioral medicine risk factors, such as health maintenance behaviors and treatment predictions, as opposed to psychosocial risk factors for implantable spinal devices. As mentioned previously, there is substantial literature examining the predictive outcomes of surgery. A few recent studies have begun to examine the relationship between behavioral medicine risk factors and treatment outcomes for spinal stimulation therapy. Overall, these studies demonstrate a relationship between behavioral medicine risk factors and treatment outcomes (Schocket et al., 2010).

There are few studies that have utilized the MBMD to compare psychosocial variables with spinal surgery outcomes. Schocket et al. (2010) included the MBMD in their presurgical evaluation of spinal surgery patients. They utilized the previous research of Block et al. (2001) that had successfully predicted patients' spinal surgery outcomes on the basis of psychosocial variables. They wanted to know whether the research findings would generalize to SCS surgery specifically and whether they could be used to assess the psychosocial differences among prognostic prescreening categories.

Patients were placed into one of five groups on the basis of an algorithm that incorporated both psychosocial and medical risk factors. The psychosocial risk factors

included a lack of social support, a history of psychological disturbance, and high pain sensitivity, as well as chronic depression, anger, and anxiety. The medical risk factors included the presurgical level of pain, number of previous surgeries, smoking, and obesity. The results of a psychologist's diagnostic interview, medical chart review, and psychological testing lead to classification into one of five categories: green (proceed with surgery), yellow (surgery with postsurgery psychological sessions), red (surgery after receiving psychological sessions, noninvasive therapy such as physical therapy recommended), and no therapy recommended. Patients in the green group, which signified a high likelihood of success with the surgery, had significantly different scores on both the MBMD and the MMPI–2 from patients who in the yellow or red groups. Specifically, patients in the green group had significantly lower levels of anger, social introversion, and depression than those in the yellow or red group. The outcome variable in this study was the ability to predict success with spinal implant surgery. The results demonstrated that by using standardized assessment, physicians are better able to predict which patients will benefit from spinal cord stimulation surgery and which patients are more likely to fail (Schocket et al., 2010).

Rationale for Study

Only one other study in the literature could be found that examined patients who chose to either proceed or not proceed after a successful temporary trial. Patients who were successful with the temporary trial only were more likely to have higher energy and lower levels of depression than were patients who failed with the trial. No other

significant findings were derived from this relatively small sample of 30 patients (Olson et al., 1998).

The lack of research in the area of temporary spinal implant is significant, as there is no clear link between psychological variables in those who proceed after the temporary implant and the psychological variables of those who never receive the permanent implant. Additionally, there is a dearth of studies with valid and reliable behavioral medicine instruments, other than the MMPI–2, in the area of SCS surgery and personality variables. In the present study, scales from the MBMD and other psychosocial variables were used to identify factors associated with success and failure with the temporary implant.

Chapter 3

Hypotheses

1. Individuals who failed with the temporary spinal cord stimulator would have significantly higher scores on the depression and guardedness psychiatric indicator scales of the MBMD than individuals who succeeded with the temporary implant.

2. Individuals who failed with the temporary spinal cord stimulator would have significantly higher scores on the socially isolated and the future pessimism stress moderator scales of the MBMD than individuals who succeeded with the temporary implant.

3. Individuals who failed with the temporary spinal cord stimulator would have significantly higher scores on the interventional fragility and problematic compliance scales of the MBMD than individuals who succeeded with the temporary implant.

4. Failure with the temporary spinal cord implant would be positively correlated with levels of depression, guardedness, and anxiety.

5. Individuals with chronic pain, irrespective of surgical outcome, would have a prototypical profile on the MBMD, including average base rates of 85 or above on the following scales: depression, anxiety, dejected, pain sensitivity, social isolation, medication abuse, future pessimism, and utilization excess.

Chapter 4

Methods

The purpose of the current study was to identify psychological characteristics of individuals, as measured by the MBMD, who were successful with the temporary implant and were approved to have the permanent surgery. Specifically, the current study identified which personality factors relate to success with the temporary implant and result in a recommendation for the permanent implant. Additionally, this analysis of personality profiles was intended to elucidate characteristics on the MBMD associated with individuals not recommended to receive the permanent implant.

Design and Design Justification

The current study was a within-subjects correlational design examining the relationship between personality variables and success with the temporary spinal cord stimulation surgery. The convenience sample of presurgical candidates was divided into patients who experienced successful temporary spinal cord stimulation surgery and those who were unsuccessful. This procedure produced dichotomous outcome variables.

Participants

Data from 66 chronic pain patients who received a temporary spinal cord stimulator to relieve extreme lower back and leg pain were examined and analyzed. These patients had been referred to an outpatient mental health practice by referring physicians from specialties including physiatry and anesthesiology in order to screen

them for approval for SCS surgery. This practice is located in central Pennsylvania and is a general mental health practice, with two psychologists specializing in behavioral medicine. Physicians request the evaluation to screen for untreated depression, active substance abuse, or any other psychological considerations that would preclude candidates from surgery. Approximately the same number of women and men were referred for the temporary surgery, 34 and 31, respectively. Additionally, the sample was primarily Caucasian, with little representation from other racial groups (62 Caucasian, 1 African American, and 3 Hispanic patients). Finally, the majority of patients evaluated (66) were approved for the trial implant, although they may have needed to take psychotropic medications (8), have outpatient psychological treatment involvement before proceeding with the surgery (8), or have additional cognitive/neuropsychological assessment (1).

Measures

The Millon Behavioral Medicine Diagnostic (Millon, 2001) is a self-report inventory that measures the impact of various psychosocial factors that impact a patient's medical treatment and adjustment to his or her illness. The MBMD provides detailed information about an individual's psychiatric conditions, coping styles, stress moderators, and treatment outcomes. This instrument is especially helpful in informing healthcare professionals who treat patients experiencing chronic pain. The MBMD was standardized by means of a moderate-sized normative sample of patients (N = 720) across six major illness groups (cancer, cardiology, diabetes, HIV, neurology, and pain). The Cronbach's alpha coefficients for most scales, including the psychiatric indicators and

stress moderators scales, were good (.74 to .89). The test−retest coefficients were moderate to strong for every scale (median = .83). The construct validity for the scales was typically moderate to high (.50 to .87). The MBMD is intended for individuals with a sixth grade reading level or above and takes approximately 20 to 25 minutes to complete. The reliability of the psychiatric indicators, which includes the depression, anxiety, guardedness, emotional lability, and cognitive dysfunction scales, is quite high.

Additionally, the background information from the evaluation included provided the patients' age, sex, medical conditions, psychological diagnosis, and psychological recommendations. Recommendations are provided based on a diagnostic interview and the MBMD, MMPI–2, and Folstein Mini Mental Status Exam scores. Success was operationally defined as a physician recommendation to have the permanent implant following a temporary trial, and failure was defined as not being recommended for the permanent implant. Not all subjects evaluated were in the success or failure group because there was some attrition. 66 patients were approved for the permanent implant, but decided not to have the surgery due to an additional complicating illness or an insurance issue.

Procedure

The data in the current study were selected from the pool of subjects who were approved for the trial surgery. During the appointment with the psychologist for the evaluation, participants consented to have their deidentified data used for future research. Only data from patients who gave informed consent to have their medical and psychological data used in this fashion comprise the data set. All patient information was

deidentified prior to analysis of the profiles. The investigator examined participants' scores on the MBMD after they had been placed into the success or failure group. Their MBMD profiles were examined, with a focus on their clinical psychiatric indicators, stress moderators, and treatment prognostics scores.

Chapter 5

Results

To test hypotheses 1 through 3, one-way MANOVAs were conducted using the outcome of the temporary surgery (success or failure) as the independent variable and the scores on each of the MBMD scales for each overall category (psychiatric indicators, stress moderators, and treatment prognostics) as the dependent variables.

To test the fourth hypothesis, that failure on the spinal cord stimulator would be positively correlated with levels of depression, guardedness and anxiety, a point biserial correlation was used.

Finally, to test the fifth hypothesis, descriptive statistics were used, and there was a visual inspection of the means of each of the scales. Scales with base rates of 85 or above were considered indicative of prominent personality features.

A one-way MANOVA was conducted to test the significance of the difference on the dependent variables of depression and guardedness between patients who failed and those who succeeded. Because the dependent variables were not correlated, the assumptions of MANOVA were not met. Two independent-groups *t*-tests were therefore conducted. The results of the Levene's test comparing the variances between the two groups on depression were significant. Assuming unequal variances, there was no significant difference between these groups on depression ($t(31.13) = -1.083$, $p = .287$). The results of the Levene's test comparing the variances between the groups on guardedness were not significant. Assuming equal variances, there was no significant difference between these groups on guardedness ($t(65) = .652$, $p = .462$).

A significant relationship was identified between scores on the social isolation scale and the future pessimism scale ($r(67) = .296$, $p = .008$). Box's test results were significant (Box's $M = 9.591$, $F(3, 11862\ .515) = .3.032$, $p = .028$). This indicates that the observed covariance matrices of the dependent variables are not equal across groups. Field (2009) recommends disregarding Box's test only if the sample sizes of the groups are equal because it is unstable and because Hotelling's trace and Pillai's trace are robust. However, in this instance, the groups are unequal, meaning that Box's test detected a violation of an assumption of MANOVA. Results of tests of the equality of error variances were not significant for social isolation ($F(1, 65) = .308$, $p = .581$**)** or for future pessimism ($F(1,65) = .060$, $p = .807$), indicating that the error variances for each dependent variable are equal across groups. Using Wilks's criterion, there was no significant difference between these groups (Wilks's lambda = .924, $F(2, 64) = 2.639$, $p = .079$), although the difference did approach significance. The same outcome was found using Hotelling's trace and Pillai's trace as the criterion.

A significant correlation was identified between scores on the interventional fragility and problematic compliance scales ($r(67) = -.314$, $p = .005$). Results of Box's test were not significant (Box's $M = 1.461$, $F(3, 11862. .515) = .462$, $p = .709$), indicating that the observed covariance matrices of the dependent variables are equal across groups. Results of Levene's tests of the equality of error variances were not significant for interventional fragility ($F(1, 65) = .05$, $p = .823$**)** or for problematic compliance ($F(1,65) = 1.029$, $p = .314$), indicating that the error variances for each dependent variable are equal across groups. A one-way MANOVA using Wilks's criterion revealed

no significant differences between the groups on these two dependent variables (Wilks's lambda = .981, $F(2, 64) = .612$, $p = .564$).

There were no significant associations between failure on the stimulator trials and anxiety ($r(67) = -.111$, $p = 185$), failure and depression ($r(67) = .119$, $p = .170$), or failure and guardedness ($r(67) = -.095$, $p = .222$).

None of the patients had average base rate scores of 85 or above on the depression, anxiety, dejected, pain sensitivity, social isolation, medication abuse, future pessimism, or utilization excess scales, meaning that the hypothesis was not supported. The average base rate for each of the scales was: depression, 59; anxiety, 41; dejected, 26; pain sensitivity, 75; social isolation, 36; medication abuse, 50; future pessimism, 72; and utilization excess, 60.

Additional analyses.

There were a number of significant correlations between scales on the MBMD. Given the large number of correlations conducted, the chances of finding significant relationships by chance alone are high. A significant relationship between reported levels of anxiety and depression on the MBMD ($r(67) = .561$, $p = .000$) was observed, the coefficient of determination indicating that 31% of the variability in depression is attributable to differences in anxiety level. Furthermore, anxiety was correlated with a number of scales, such as functional deficits ($r(67) = .541$, $p = .000$), pain sensitivity ($r(67) = .642$, $p = .000$), social isolation ($r(67) = .549$, $p = .000$), and interventional fragility ($r(67) = .426$, $p = .000$). Coefficients of determination were calculated and revealed that approximately 29% of the variability in functional deficits is attributable to

differences in level of anxiety. Approximately 41% of the variability in pain sensitivity is attributable to differences in level of anxiety. Approximately 29% of the variability in social isolation is attributable to differences in anxiety level, while 18% of the variability in interventional fragility is associated with differences in levels of anxiety.

Multiple regression analysis, with depression and anxiety as predictors of several different criteria, was conducted. The overall regression equations yielded results that were significantly different from chance on a number of factors, including social isolation ($F(2,64) = 14.615$, $p = .000$). Although the overall equation was significantly different from chance, only depression made a significant contribution to the prediction of social isolation ($b = .419$; standard error of $b = .110$; standardized $b = .476$, $t = 3.808$, $p = .000$). Similarly, using anxiety and depression to predict pain sensitivity, the overall regression equation was significantly different from chance ($F(2, 64) = 24.284$, $p = .000$). However, only depression made a significant contribution to the prediction of pain sensitivity ($b = .305$, standard error of $b = .063$, standardized $b = 550$, $t = 4.831$, $p = .000$). Finally, although the overall equation using depression and anxiety as predictors of interventional fragility was significant ($F(2,64) = 72.432$, $p = .000$), only anxiety made a significant contribution to predicting levels of the interventional fragility scale ($b = .745$; standard error of $b = .072$; standardized $b =\ .864$, $t = 10.344$, $p = .000$). Approximately 69% of the variability in interventional fragility is associated with differences in anxiety levels (adjusted $r^2 = .684$).

Chapter 6

Discussion

Levels of depression were not significantly correlated with success or failure with surgery. This is surprising, given that previous studies have demonstrated a significant relationship between depression and surgical outcomes with spinal stimulation surgery (Olson, 1998). The power of the current study was lower than expected, which likely resulted in a failure to distinguish between individuals who succeeded with surgery and those who did not.

Previous research using the MMPI–2 demonstrated that elevations on the first three clinical scales, including the depression scale, are associated with nonorganic signs of low back pain and are related to ineffective coping (Waddell, Pilowsky, & Bond, 1989). Similar to the current study, it is likely that depression and poor coping styles are inextricably linked and are associated with a number of outcome-focused variables, such as heightened pain sensitivity and poor response to medical interventions. Depressed chronic pain patients often report higher levels of pain following surgical procedures (Bruns & Disorbio, 2009).

Previous research has also linked high levels of depression with poor outcomes following spinal stimulation surgery (Burchiel et al., 1995). In a study using the MMPI–2 to predict patient outcomes, the depression scale was the best prognostic indicator for success with spinal column surgery. As in similar studies, coping was believed to be an important moderating factor between depression and effective medical intervention. The current study offers additional clarity in this area, as patient levels of pain sensitivity can

be predicted by their level of depression. This finding is likely to offer valuable and more nuanced information to treating physicians who are attempting to select appropriate patients for SCS surgery.

Levels of anxiety were also not significantly correlated with surgical outcome. Given the high volume of previous research supporting a significant relationship between anxiety and surgical outcome, this is surprising. It is likely that the low power of the current study may have failed to detect a possible difference between groups on surgical outcomes. In a previous study by Wade, Dougherty, Hart, Raffii, and Price (1992), anxiety emerged as the most important factor in predicting the degree of illness behavior associated with pain procedures. In conjunction with the current data, it appears that a vulnerability to anxiety is predictive of a number of important health related outcomes. High levels of anxiety appear to negatively impact a patient's level of interventional fragility, which is the ability to adequately follow treatment recommendations and adopt the necessary lifestyle changes without becoming overwhelmed with fear. Additionally, both depression and anxiety are associated with greater pain perception in many medical populations. Identifying depression and anxiety early in treatment may be an essential component in improving outcomes after surgery.

Level of guardedness was not significantly related to surgical outcomes. This finding is also unexpected, given that previous studies demonstrated a significant relationship between levels of guardedness and SCS surgical outcomes (den Boer et al., 2006). Again, it is possible that the power of the current study was too low to detect differences between surgical outcome groups that may have existed.

Although the results for the hypothesis that higher scores on the socially isolated and future pessimism scales would be correlated with temporary implant failure approached significance, the sample size was likely too small to detect differences between groups. It is possible that with a larger sample size, scores on these could predict success or failure with SCS surgery. Social isolation was predicted by patients' levels of depression on the MBMD. This connection has been found in previous research directly related to chronic pain interventions. Extroverts tend to cope with painful procedures and chronic pain more adaptively and with fewer side effects than do introverts (Morasso, Costantini, Baracco, Borreani, & Capelli, 1996). Additionally, the presence of chronic pain has been found to lead to more introversion and social withdrawal. Pain patients are often internally preoccupied with physical discomfort, leaving them with less energy and motivation to engage with others. Research in this area has demonstrated that individuals with a high level of chronic pain become so distracted by their pain that they begin to have difficulty recognizing their emotions. As a result, they experienced diminished and constricted affect, which acts as a hindrance to social and emotional relationships (Millard & Kinsler, 1992).

In general, previous research demonstrates a significant link between introversion, social withdrawal, and increasing levels of chronic pain (Baum, Gatchel, & Krantz, 1997). One explanation of the importance of social isolation in the current study is to recognize the potential mediating factor that positive social connections have on the experience of chronic pain. Being well connected with others may influence a person's reaction to his or her pain, increase the level of support he or she has from others, and increase his or her expression of feelings and overall social activity.

The current study failed to find a significant relationship between surgical outcomes and levels of future pessimism. Again, this may be explained by the low power of the current study. The research literature identifies a strong link between surgical outcomes, pessimism, and social isolation. For example, Carver et al. (1993) found that breast cancer patients had faster recovery times after surgery and better physical outcomes when they were more optimistic. Optimism increased these patients' level of acceptance and positive reframing and decreased their levels of behavioral disengagement and denial.

Optimism is likely to have a beneficial effect on health outcomes for a number of reasons. Optimism tends to mitigate the effects of stress on physical and mental health (Härkäpää, Järvikoski, & Estlander, 1996). Remaining positive and having positive expectations about surgery improves a patient's psychological adjustment to illness and medical interventions. This improved psychological adjustment likely directly contributes to improved treatment outcomes, as well. A high level of optimism correlated with reduced distress and greater quality of life 1 year postsurgery (Carver et al., 1993).

Another possible mechanism involving optimism pertains to the use of coping strategies. Optimists tend to cope more effectively with illness in general than less optimistic people (Fitzgerald, Tennen, Affleck, & Pransky, 1993). Being optimistic increases the repertoire of positive coping skills that lead to better adjustment following illness. Optimists rely more on problem-focused coping strategies, whereas pessimists rely more on emotion-focused coping. Optimists continue to engage in coping strategies, such as exercise, even when they experience emotional pain, whereas pessimists are far

more likely to disengage when they feel overwhelmed. Pessimists are also more likely to disengage socially, which has an equally negative impact on a patient's adjustment to illness and pain.

The current study failed to find a relationship between surgical outcomes and levels of interventional fragility or problematic compliance. Low statistical power is possibly the reason that significant differences were not found between surgical outcome and interventional fragility and problematic compliance. The current study did find that level of anxiety predicted level of interventional fragility and problematic compliance. The research has demonstrated a significant relationship between depression, anxiety, and ability to emotionally and behaviorally adjust to medical interventions. It is likely that patients with positive coping strategies are protected from the negative effects of depression and anxiety. This idea is consistent with previous research findings by Jensen, Turner, Romano, and Karoly (1991) that found a relationship between wellness-focused coping, lower levels of depression, and positive health outcomes for chronic pain patients. When individuals feel that they have control over their experienced levels of pain, their mood and adjustment following medical intervention improves (Jensen et al., 1991).

Anxiety and depression are relatively typical responses to serious medical limitations and interventions (Antoni, 1991). However, when responses to medical situations are left unchecked, this can significantly impact positive coping skills and treatment prognostic indicators, such as pain sensitivity and interventional fragility. Anxiety and depression increase the emotional pain that an individual experiences during a medical or surgical procedure. Additionally, these factors impact an individual's ability

to adopt positive lifestyle changes to recover from surgery, engage in rehabilitation programs, and o return to premorbid levels of interpersonal and occupational functioning (Bremer, 1995).

Knowing the negative impact that depression and anxiety can have on patients experiencing chronic pain, it is important to consider psychosocial treatment interventions. There are a number of factors that can mitigate maladaptive depression and anxiety responses, such as realistic cognitive appraisals, a variety of coping strategies, available social support, and a number of contextual factors. Patients who engage in cognitive restructuring have better emotional adjustment to their illness, whereas patients who engage in self-blame and denial evidence poor adjustment. Having an internal locus of control and greater perceived control over illness significantly decreases levels of distress. Lower levels of helplessness were associated with improved emotional adjustment and decreased experiences of chronic pain in a study of cancer patients (Burgess, Morris, & Pettingale, 1988).

Psychologists are in an excellent position to diagnose and treat anxiety and depression during their evaluations of chronic pain patients. The current research has confirmed the negative impact that depression, and to a greater extent, anxiety can have on health-related outcomes following surgery. Psychotherapy prior to surgery is likely to assist in lowering patients' experienced levels of anxiety and depression, thus improving SCS surgery outcomes. Cognitive behavioral therapy (CBT) is an empirically supported intervention for the treatment of depression and anxiety and has support for treating patients with chronic pain, as well. A meta-analysis conducted by Morley, Eccleston, and Williams (1998) found that chronic pain patients receiving short-term cognitive

behavioral therapy had significant reductions in experienced levels of pain, decreased depression and anxiety, and reduced behavioral expressions of pain. Consistent with previous research, it was concluded the cognitive behavioral therapy helped to change expectations and subjective experiences of pain. Active psychological interventions, such as CBT, were significantly more effective than no intervention or traditional psychotherapy (Morley, Eccleston, & Williams, 1998).

No significant differences in outcome were found between demographic variables, such as race or sex. Twenty-six of 36 men were successful with the surgery, in comparison to 25 of 31 women. One study examined the demographic differences between outcomes of SCS surgery and found that men were more successful with the surgery overall (North et al., 2006). One explanation for this finding was that men had lower levels of somatization and anxiety than women. This is consistent with the current study, which found that lower levels of anxiety are related to positive medical predictors.

The lack of main effect in the original three hypotheses related to surgical outcome was likely due to the small sample size and to reliance on patient self-report of at least a 50% reduction in pain levels (Olson et al., 1998) for determining the success of the temporary implant. As mentioned previously, many of the participants in this study had undergone many other interventions, including surgical and pharmacological interventions, and had not experienced adequate pain relief. Given the lack of other treatment options, the patients' strong desire for an effective intervention may impact their subjective sense of benefit. If patients who did not benefit from the temporary implant nonetheless received the permanent stimulator, then the data would not adequately reflect differences between people who benefit and those who do not.

An additional limitation is related to the fifth hypothesis, which examined potential scale elevations of 85 or above on the MBMD. Although scale elevations of this magnitude indicate prominent features of personality, base rates of 75 are often used to indicate strong traits of dysfunction (Millon, Anoni, Millon & Davis, 1997). Had the current study operationalized scale elevations of 75 as the cutoff, the findings would have demonstrated that pain sensitivity was a strong indicator of this specific chronic pain population's personality feature. Additionally, future pessimism approached a base rate of 75, indicating that levels of pessimism may be an important area of intervention for clinicians treating these individuals.

Additional limitations include the small sample consisting of a relatively narrow demographic in central Pennsylvania. Also, many patients who had been approved for the temporary surgery opted not to have the permanent surgery for a number of reasons, including additional medical issues and insurance concerns. Future research should utilize a larger and more diverse sample. Moreover, future research in this area should include an equal number of temporary implant failures and successes. Such inclusion will ensure adequate power in differentiating between groups on various dimensions of personality.

Future research in this area could include an examination of the effect that age and other cultural factors may have on the perception of chronic pain. Wandner, Scipio, Hirsh, Torres, and Robinson (2011) examined how various cultural factors influenced patients' perception of pain. These researchers discovered that there are some differences in how different cultures report and experience pain. They discovered that Caucasians are both more sensitive to pain and more likely to report pain than African Americans,

Asian Americans, or Hispanics. Additionally, the researchers discovered that older individuals are more pain sensitive and willing to report than younger people (Wander, Scipio, Hirsh, Torres, & Robbinson, 2011). It may be interesting to assess how a younger and more diverse sample of participants responds to SCS surgery.

Demmelmaier, Lindberg, Asenlof, and Denison (2008) examined the impact that duration of experienced pain can have on the level of disability of chronic pain patients. They discovered that patients who have been experiencing chronic pain for longer periods are more likely to catastrophize and to expect to continue to experience pain in the future. Previous research has demonstrated that patients' expectations of recovery predict their ability to return to work and the severity of disability (Schultz, Crook, & Meloche, 2004). The current study did not take into account the duration of pain. Future research should investigate the relationship between duration of pain and outcomes with spinal stimulation surgery. Additionally, it may be helpful to examine the level of disability experienced by chronic pain patients. Patients with low back pain who have more awareness of their pain and more vigilance are significantly more likely to be disabled (Roelofs, Peters, Patijn, Schouten, & Vlaeyen, 2004). However, another study found that the severity of the pain or the awareness of chronic pain is not related to level of disability (Crombez, Vlaeyen, Huets, & Lysens, 1999). It is important to recognize that experienced pain level and level of disability represent two separate constructs that can be operationalized differently among studies. Disability could be operationalized differently, depending on the context of the evaluation.

Health-related quality of life is an important component in the treatment of chronic pain. The current study did not assess quality of life, which has been found to be

significantly lower than normal in the chronic pain population. A previous study confirmed that chronic low back pain patients' quality of life can be significantly improved following lumbar spinal surgery (Saban, Penckofer, Androwich, & Bryant, 2007).

Additionally, in an effort to improve successful outcomes with surgery, future research should consider the treatments prior to receiving SCS. Previous research has linked number of years of unsuccessful pharmacological treatments with increased levels of chronic pain (Vallejo, 2012). It is possible that the number of unsuccessful interventions is related to outcome following SCS surgery, and future research should explore this area. For instance, is there a difference in surgical outcome when people have explored had more treatments prior to surgery rather than fewer options?

Future research is needed to examine the ability of the MBMD to predict positive outcome following the permanent SCS implant. Although many participants in the current sample who did not obtain adequate relief from the temporary implant opted to receive the permanent stimulator, it is possible that they will obtain adequate long-term relief. It is also likely that more stable patterns of personality dysfunction will affect long-term adherence to (patients have to manually control the stimulator and adjust the strength of the device based on their experienced level of pain) and relief from the permanent stimulator. Finally, future research should use the results of the current study, specifically the strength of the relationship between depression and anxiety as predictors of health-related outcomes, to accurately predict patient who are likely to succeed with SCS surgery.

References

Ackroyd, R., Dudley, J. B., Graves, J., McVey J., & Horton S. (2005). Survey of assessment criteria prior to implantation of spinal cord stimulators in United Kingdom pain management centres. *European Journal of Pain, 9,* 57-60.

Alo, K., & Holsheimer, J. (2002). New trends in neuromodulation for the management of neuropathic pain. *Neurosurgery, 50,* 690-704.

Antoni, M. H., Millon, C., & Millon, T. (1997). The role of psychological assessment in health care: The MBHI, MBMC, and beyond. In T. Millon (Ed.), *The Millon inventories: Clinical and personality assessment* (pp. 409-448). New York, NY: Guilford.

Atkinson, M. J. (2005). Review of the Millon Behavioral Medicine Diagnostic. *Journal of Applied Psychology, 25,* 213-222.

Barnes, D., Smith, D., Gatchel, R. J., & Mayer, T. G. (1989). Psycho-socioeconomic predictors of treatment success/failure in chronic low back pain patients. *Spine, 14,* 427-430.

Barret, J. F., Rose, R. M., & Klerman, G. L. (Eds.). (1997). Stress and mental disorder. New York, NY: McGraw-Hill.

Baum, A., Gatchel, R. J., & Krantz, D. S. (1997). *Introduction to health psychology* (3rd ed.). New York, NY: McGraw-Hill.

Becker N., Bondegaard, T. A., Olson, A. K., Sjorgren P., Bech P., & Eriksen J. (1997). Pain epidemiology and health related quality of life in chronic non-malignant pain patients referred to a Danish multidisciplinary pain center. *Pain, 73,* 393-400.

Bell, G. K., Kidd, D., & North, R. B. (1997). Cost effectiveness analysis of spinal cord stimulation in treatment of failed back surgery syndrome. *Journal of Pain Symptom Management, 13,* 286-295.

Beltrutti, D., Lamberto, A., Barolat, G., Bruehl, S. P., Doleys, D., Krames, E. S., & Melzack, R. (2004). The psychological assessment of candidates for spinal cord stimulation for chronic pain management. *Pain Practice, 4,* 204-221.

Block, A. R., Ohnmeiss, D. D., Guyer, R. D., Rashbaum, R. F., & Hochschuler, S. H. (2001). The use of presurgical psychological screening to predict the outcome of spine surgery. *Spine Journal, 1,* 274-282.

Borchgrevink, G. E., Stiles, T. C., Borchgrevink, P. C., & Lereim, I. (1997). Personality profile among symptomatic and recovered patients with neck sprain injury, measured by MCMI−I acutely and 6 months after car accidents. *Journal of Psychosomatic Research, 42*(4), 357-367.

Boswell M. V., Trescot A. M., Datta S., Schultz D. M., Hansen H. C., Abdi S., . . . Manchikanti, L. (2007). Interventional techniques: evidence-based practice guideline in the management of chronic spinal pain. *Pain Physician, 10,* 7-111.

Bremer, B. (1995). Absence of control over health and the psychological adjustment to end-stage renal disease. *Annals of Behavioral Medicine, 17,* 227-233.

Bruns, D., & Disorbio, J. M. (2009). Assessment of biopsychosocial risk factors for medical treatment: A collaborative approach. *Journal of Clinical Psychology, 16,* 127-147.

Burchiel, K. J., Anderson, V. C., Brown, F. D., Fessler, R. G., Friedman, W. A., Pelofsky, S., Weiner, R. L., Oakley, J., & Shatin, D. (1996). Prospective,

multicenter study of spinal cord stimulation for relief of chronic back and extremity pain. *Spine, 21,* 2786-2794.

Burchiel, K. J., Anderson, V. C., Wilson, B. J., Denison, D. B., Olson, K. A., & Shatin, D. (1995). Prognostic factors of spinal cord stimulation for chronic back and leg pain. *Neurosurgery, 36,* 1101-1110.

Burgess, C., Morris, T., & Pettingale, K. W. (1998). Psychological response to cancer diagnosis: II: Evidence for coping styles (coping syles and cancer diagnosis). *Journal of Psychosomatic Research, 32,* 263-272.

Bush, S. S. (2009). Determining whether or when to adopt new versions of psychological and neuropsychological tests: Ethical and professional considerations. *Clinical Neuropsychologist, 24,* 7-16.

Butcher, J. N., Dahlstrom, W. G., Graham, J. R., Tellegen, A., & Kaemmer, B. (1989). *Manual for the restandardized Minnesota Multiphasic Personality Inventory: MMPI–2*. Minneapolis, MN: University of Minnesota Press.

Carver, C. S., Pozo. C., Harris, S. D., Noriega, V., Scheier, M. F., Robinson, D. S., . . . Clark, K. C. (1993). How coping mediates the effect of optimism on distress: A study of women with early stage breast cancer. *Journal of Personality and Social Psychology, 65,* 375-390.

Costello, R. M., Hulsey, T. L., Schoenfeld, L. S., & Ramamurthy, S. (1987). P-A-I-N: A four-cluster MMPI typology for chronic pain. *Pain, 30,* 199-209.

Crombez, G., Vlaeyen, J. W. S., Huets, P. H. G. T., & Lysens, R. (1999). Pain-related fear is more disabling than pain itself: Evidence on the role of pain-related fear in chronic back pain disability. *Pain, 80,* 329-339.

Crook, J., Tunks, E., & Rideout E. (1986). Epidemiologic comparison of persistent pain sufferers in a specialty clinic and in the community. *Archive of Physical Medical Rehabilitation.*

67, 451– 455.

Cruess, D. G., Meagher, S., Antoni, M. H., & Millon, T. (2007). Utility of the Millon Behavioral Medicine Diagnostic (MBMD) to predict adherence to highly active antiretroviral therapy (HAART) medication regimens among HIV-positive men and women. *Journal of Personality Assessment, 89,* 277-290.

Daniel, M. S., Long, C., Hutcherson, W. L., & Hunter, S. (1985). Psychological factors and outcome of electrode implantation for chronic pain. *Neurosurgery, 20,* 773-777.

Davis, F. N. (1999). Functional rehabilitation of employees with chronic musculoskeletal pain. *Case Manager, 10,* 55-59.

Demmelmaier, I. R. T., Lindberg. P., Asenlof, P., & Denison, E. (2008). The associations between pain intensity, psychosocial variables, and pain duration/recurrence in a large sample of persons with nonspecific spinal pain. *Clinical Journal of Pain, 24,* 611-619.

den Boer, J. J., Oostendorp, R. A., Beems, T., Munneke, M., Oerlemans, M., & Evers, A. W. (2006). A systematic review of bio-psychosocial risk factors for an unfavourable outcome after lumbar disc surgery. *European Spine Journal, 15,* 527-536.

Dixon K. E., Keefe F. J., & Scipio C. D. (2007). Psychological interventions for arthritis pain management in adults: a meta-analysis. *Health Psychology, 26,* 527-536.

Disorbio, J. M., Bruns, D., & Barolat, G. (2006). Assessment and treatment of chronic pain: A physician's guide to a biopsychosocial approach. *Practical Pain Management, 6*(2), 11-27.

Elliot, T. R., Jackson, W. T., Layfield, M., & Kendall, D. (1996). Personality disorders and response to outpatient treatment of chronic pain. *Journal of Clinical Psychology in Medical Settings, 3,* 219-234.

Field, A. (2009). *Discovering statistics* (3rd ed.). London, CA: Sage.

Fitzgerald, T., Tennen, H., Affleck, G., & Pransky, G. (1993). Relative importance of dispositional optimism and control appraisals in quality of life after coronary artery bypass surgery. *Journal of Behavioral Medicine, 16,* 25-43.

Gatchel, R. J. (1991). Early development of physical and mental deconditioning in painful spinal disorders. In T. G. Mayer, V. Mooney, & R. J. Gatchel (Eds.), *Contemporary conservative care for painful spinal disorders* (pp. 278-289). Philadelphia, PA: Lea & Febiger.

Gatchel, R. J. (1997). Biofeedback. In A. Baum, C. McManus, S. Newman, J. Weinman, & R. West (Eds.), *Cambridge handbook of psychology, health and medicine* (pp. 197-199). London, England: Cambridge University Press.

Gatchel, R. J., Deckel, A. W., Wienberg, N., & Smith, J. E. (1985). The utility of the Millon Behavioral Health Inventory in the study of chronic headaches. *Headache, 25,* 49-54.

Gatchel, R. J., Mayer, T. G., Capra, P., Diamond, P., & Barnett, P. (1986). Millon Behavioral Health Inventory: Its utility in predicting physical function in patients

with low back pain. *Archives of Physical Medicine and Rehabilitation, 57,* 878-882.

Goossens, M. E. J. B., & Evers, S. M. A. A. (1997). Economic evaluation of back pain interventions. *Journal of Occupational Rehabilitation, 7,* 15-32.

Härkäpää, K., Järvikoski, A., & Estlander, A.-M. (1996). Health optimism and control beliefs as predictors for treatment outcome of a multimodal back treatment program. *Psychology and Health, 12,* 123-134.

Holsheimer, J. (1997). Effectiveness of spinal cord stimulation in the management of chronic pain: Analysis of technical drawbacks and solutions. *Neurosurgery, 40,* 990-996.

Jamison, N. R., Washington, A. T., Fanciullo, J. G., Ross, E. L., McHugo, G. J., & Baird, J. C. (2008). Do implantable devices improve mood? Comparisons of chronic pain patients with or without an implantable device. *Neuromodulation, 11,* 260-266.

Jensen, M. P., Turner, J. A., Romano, J. M., & Karoly, P. (1991). Coping with chronic pain: A critical review of the literature. *Pain, 47,* 249-283.

Keller, L. S., & Butcher, J. N. (1991). Assessment of chronic pain patients with the MMPI–2. Minneapolis, MN: University of Minneapolis Press.

Kim, K. J., Yoon, Y. W. & Chung, J. M. (1997). Comparison of three rodent neuropathic pain models. *Experimental Brain Research, 113,* 200-206.

Kumar, K., Malik, S., & Demeria, D. (2002). Treatment of chronic pain with spinal cord stimulation versus alternative therapies: Cost-effectiveness analysis. *Neurosurgery, 51,* 106-116.

Millard, R. W., & Kinsler, B. L. (1992). Evaluation of constricted affect in chronic pain: An attempt using the Toronto Alexythymia Scale. *Pain, 50,* 287-292.

Millon. T., Antoni, M., Millon, C., & Davis, R. (1997). *MBMC−R (Millon Behavioral Medical Consult) Staff Rating scale.* Minneapolis, MN: NCS Pearson.

Moldovan, A. R., Onac, I. A., Vantu, M., Szentagotai, A., & Onac, I., (2009). Emotional distress, pain catastrophizing and expectancies in patients with low back pain. *Journal of Cognitive and Behavioral Psychotherapies, 9,* 83-93.

Mok, C. L., & Lee, F. K. I. (2006). Anxiety, depression and pain intensity in patients with low back pain who are admitted to acute care hospitals. *Journal of Clinical Nursing, 17,* 1471-1480.

Morasso, G., Costantini, M., Baracco, G., Borreani, C., & Capelli, M. (1996). Assessing psychological distress in cancer patients: Validation of a self-administered questionnaire. *Oncology, 53,* 295-302.

Morley, S., Eccleston, C., & Williams, A. (1998). Systematic review and meta-analysis of randomized controlled trials of cognitive behavior therapy and behavior therapy for chronic pain in adults, excluding headache. *Pain, 80,* 1-13.

Murphy, J., Sperr, E., & Sperr, S. (1986). Chronic pain: An investigation of assessment instruments. *Journal of Psychosomatic Research, 30,* 289-296.

Naber, D., Weinberger, D. R., Bullinger, M., Polsby, M., & Chase, T. N. (1988). Personality variables, neurological and psychopathological symptoms in patients suffering from spasmodic torticollis. *Comprehensive Psychiatry, 29,* 182-187.

National Institutes of Health (1998). New directions in pain research: I. Retrieved from: http://grants.nih.gov/grants/guide/pa-files/PA-98-102.html

North, R., Kidd. D., Wimberly, R., & Edwin, D. (1996). Prognostic value of psychological testing in patients undergoing spinal cord stimulation: A prospective study. *Neurosurgery, 39,* 301-311.

Olson, K., Marshall, B., Anderson, V., Burchiel, K., & Villanueva, M. (1998). Psychological variables associated with outcome of spinal cord stimulation trails. *Neuromodulation, 1,* 6-13.

Riley, J. L., Robinson, M. E., Geisser, M. E., & Wittmer, V. T. (1993). Multivariate cluster analysis of the MMPI–2 in chronic low-back pain patients. *Clinical Journal of Pain, 9,* 248-252.

Riley, J. L., Robinson, M. E., Geisser, M. E., Wittmer, V. T., & Smith, A. G. (1995). Relationship between MMPI–2 cluster profiles and surgical outcome in low-back pain patients. *Journal of Spinal Disorders, 8,* 213-219.

Roelofs, J., Peters, M. L., Patijn, J., Schouten, E. G. W., & Vlaeyen, J. W. S. (2004). Electronic diary assessment of pain-related fear, attention to and pain intensity in chronic low back pain patients. *Pain, 112,* 335-342.

Romano, J. M., & Turner, J. A. (1985). Chronic pain and depression: Does the evidence support such a relationship? *Psychological Bulletin, 97,* 18-34.

Rozensky, R. H., Honor, L. F., Tovian, S. M., Herz, G., & Holland, M. A. (1985). Tolerance of pain by cancer patients in hyperthermia treatment. *Journal of Psychosocial Oncology, 3,* 75-82.

Ruchinskas, R., & O'Grady, T. (2000). Psychological variables predict decisions regarding implantation of a spinal cord stimulator. *International Neuromodulation Society, 3,* 183-189.

Saban, K. L, Penckofer, S. M., Androwich, I., & Bryant, F. B. (2007). Health-related quality of life of patients following selected types of lumbar spinal surgery: A pilot study. *Health and Quality of Life Outcomes, 5,* 1-11.

Schocket, K. G., Gatchel J. R., Stowell, W. A., Deschner, M., Robinson, R., Lou, L., . . . Bernstein, D. (2008). A demonstration of a presurgical behavioral medicine evaluation for categorizing patients for implantable therapies: A preliminary study. *International Neuromodulation Society, 11,* 237-248.

Schultz, I., Crook. J., & Meloche. G. (2004). Psychosocial factors predictive of occupational low back disability: Towards development of return-to-work model. *Pain, 107,* 77-85.

Schwarz, M. S., & Krupp, N. E. (1971). The MMPI "conversion V" among 50,000 medical patients: A study of incidence, criteria, and profile elevation. *Journal of Clinical Psychology, 27,* 89-95.

Shealy, C. N., Taslitz, N., Morimer, J. T., & Becker, D. P. (1967). Electrical inhibition of pain: experimental evaluation. *Anesthesiology, 46,* 299-305.

Strategier, D. L, Chwalisz, K., Altmair, M. E., Russell, W. D., & Thomas, R. L. (1997). Multidimensional assessment of chronic low back pain: Predicting treatment outcomes. *Journal of Clinical Psychology, 4,* 91-110.

Tunks, R. E., Crook, J., & Weir, R. (2008). Epidemiology of chronic pain with psychological comorbidity: prevalence, risk, course, and prognosis. *Canadian Journal of Psychiatry, 53,* 224-234.

Turk, D., & Rudy, T. (1998). Toward an empirically derived taxonomy of chronic pain patients: Integration of psychological assessment data. *Journal of Consulting and Clinical Psychology, 56,* 233-238.

Vallejo, R. (2012). High-frequency spinal cord stimulation: An emerging treatment option for patients with chronic pain. *Techniques in Regional Anesthesia and Pain Management, 16,* 106-112.

Waddell, G., Pilowsky, I., & Bond, M. R. (1989). Clinical assessment and interpretation of abnormal illness in low back pain. *Pain, 39,* 41-53.

Wade, J. B., Dougherty, L. M., Hart, R. P., Rafii, A., & Price, D. D. (1992). A canonical correlation analysis of the influence of neuroticism and extraversion on chronic pain, suffering, and pain behavior, *Pain, 51,* 67-73.

Wandner, L. D., Scipio, C. D., Hirsh, A. T., Torres. C. A., & Robinson, M. E. (2011). The perception of pain in others; how gender, race, and age influence pain expectations. The *Journal of Pain, 13,* 220-227.

Weaver, K., Llabre, M., Durán, R. E., Antoni, M. H., Ironson, G., Penedo, F., Ironson, G., Penedo, F. J., & Schneideman, N. (2005). A stress and coping model of medication adherence and viral load in HIV+ men and women on highly active antiretroviral therapy. *Health Psychology, 24,* 385-392.

Weiner, D. K., Sakamoto, S., Perera, S., & Breuer, P. (2006). Chronicity of low back pain in older adults: Prevalence, reliability, and validity of physical examination findings. *Journal of the American Geriatrics Society, 54,* 11-20.

Whal, K. A., Rustoen, T., Rokne, B., Lerdal, A., Knudsen, O., Miaskowski, C., & Moum, T. (2009). The complexity of the relationship between chronic pain and quality of

life: A study of the general Norwegian population. *Quality of Life Research, 18*, 971-980.

Wilcoxson, M. A., Zook, A., & Zarski, J. J. (1988). Predicting behavioral outcomes with two psychological assessment methods in an outpatient pain management program. *Pain, 4*, 310-333.

Wise, A. E., & Streiner, D. L. (2010). A comparison of the Millon Behavioral Medicine Diagnostic and Millon Behavioral Health Inventory with medical populations. *Journal of Clinical Psychology, 66*, 1281-1291.