PSYCHOLOGICAL FACTORS AS PREDICTORS FOR

SUCCESSFULL SPINAL CORD STIMULATION OUTCOME

In collaboration with Diakonessenhuis

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Abstract

Spinal Cord Stimulation (SCS) has been used for decades to reduce chronic pain. It was always the medical doctor who decided whether a patient qualifies for the procedure (British Pain Society, 2009). Recent research has demonstrated that psychological factors such as anxiety, depression, poor coping strategies, and cognitive impairments all have an influence on successful SCS-outcomes (Blackburn et al., 2016; Stephenson, 2016). Several organizations tried to include the roll of psychologists and psychological factors in their guideline, but there is still no consensus. One thing the organizations have in common is that they claim that psychological assessment cannot be used as a predictor of a successful SCS-outcome. Due to lack of clarity the Diakonessenhuis questioned the way it was using their psychological assessment. The aim of the present study is to examine whether the psychological assessment, used by the Diakonessenhuis, yields valid information based on which it is possible to make a good prediction on successful SCS-outcome. To do this, a mediation analysis was conducted in which four psychometric tests – the Pain Coping Inventory, the Illness Cognition Questionnaire, the Hospital Anxiety and Depression Scale, and the Pain Catastrophizing Scale – were the independent factors, SCS-outcome the dependent factor, and recommendation the mediator. Data relating to 69 patients were collected from the electronic patient dossier of the Diakonessenhuis. The results demonstrate that psychological assessment does not provide a predictive value for successful SCS-outcome, and hence recommendation does not serve as a mediator. The psychological assessment should therefore not be used to predict successful SCS-outcome. However, it could still potentially be used to monitor psychological factors that might influence a successful outcome. The study had several limitations, including a small sample size and limited variability in the recommendations which might have influenced the power of the study. Further research is recommended.

Preface

This thesis was written as part of a master's degree in Clinical Psychology at Utrecht University and undertaken in collaboration with the Diakonessenhuis in Zeist, the Netherlands. One of my goals, as a master's student, was to gain experience in a number of different workplaces, dealing with different psychological issues. I am glad that I undertook the research at a hospital, as this gave me the opportunity to be introduced to a subject I was not familiar with, namely the psychological effects of chronic pain. It also gave me the opportunity to experience working in a hospital environment.

I would like to thank everyone who provided me with information at the Diakonessenhuis, especially Baukje Wertheim, who not only answered all my questions, but also provided me with valuable feedback on my thesis. In particular, I would like to thank my supervisor, Bart Vos. He provided critical feedback, which challenged me to do better. In addition, the conversations and discussions we had on the subject helped me to delimit the research question.

Utrecht, April 2019

Sammya Massoud Kahsay

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Introduction

It is estimated that between 20 to 35 percent of adults experience chronic pain (Roditi & Robinson, 2011). Chronic pain is distinguished from acute pain on the basis of its persistence, chronicity, physiological maintenance mechanism, and its negative impact on a person's life. It is recognized as pain that persists past the normal healing time, considered to be anywhere from three to six months. As a result of its chronic nature, the pain loses its warning function (Roditi & Robinson, 2011; Treede et al., 2015).

Traditionally, analgesic drugs and adjuvant medication are used to treat chronic pain (Beltrutti et al., 2004). Treatment is focused not on eliminating the locus of pain, but rather on managing the chronic pain so that the subjective experience can improve (Roditi & Robinson, 2011). Unfortunately, the traditional analgesic modalities do not always work for everyone. With these drugs, some patients are unable to control their clinical symptomatology. In such cases, neurostimulation can be used. Neurostimulation is a pain control technique that focuses on nerve stimulation through electrical pulses. These pulses modulate the pain signal before it reaches the brain. Spinal Cord Stimulation (SCS) is a form of neurostimulation used on patients with chronic pain (Beltrutti et al., 2004).

SCS has been used as a way to treat pain since 1967. There is significant supportive evidence corroborating claims that this surgical procedure reduces unpleasant sensory experiences of pain (The British Pain Society, 2009). The focus of the treatment is to increase the patient's functioning. SCS can provide long-term pain relief, a reduction of medication, improvement in psychological well-being, and make it possible for the patient to participate in everyday activities, including working. Overall, the decrease in pain increases the quality of life (ACC, n.d.). Several researchers have demonstrated that psychological factors – including somatization, anxiety, poor coping abilities (Celestin, Edward & Jamison, 2009 in Blackburn et al., 2016), depression (Sparkes, Raphael, Duarte, LeMarchand, Jackson & Ashford RL, 2010 in Blackburn et al., 2016), cognitive impairments, and inadequate social support (Atkinson et al., 2011 in Blackburn et al., 2016) – might be associated with poor SCS-outcome. As a result, efficacy reviews now indicate that psychological factors should be included in the pre-treatment assessment (Block, Ohnmeiss, Guyer, Rashbaum & Hochschuler, 2001; Dworkin et al., 2005; Cruccu et al., 2007).

The National Institute for Health and Clinical Excellence (NICE, 2008) as well as The British Pain Society (2009) developed guidelines for the SCS procedure. Their guidelines, however, barely discuss the psychological criteria for the selection of patients. The British Pain Society (2009) only briefly mentions that assessment by a psychologist is desirable for assessing the preoperative psychological conditions, such as the patient's beliefs, expectations, and understanding of the treatment and to discuss pain management strategies. According to this society, it is the psychologist's job to monitor the pre- and post-operation progression of the patient. They also make it clear that psychological testing cannot predict a successful SCS-outcome.

The Accident Compensation Corporation (ACC, n.d.; 2012) has also created a guideline for SCS procedure. Their guideline focuses more on the social and psychological components of the procedure. They emphasize the importance of a multidisciplinary team, which should consist of a psychologist or psychiatrist, a pain management specialist, and an occupational therapist or physiotherapist. The ACC divided the inclusion and exclusion criteria into four sections: general inclusion criteria, relative general exclusion criteria, psychological consideration factors, and other relative contraindications. In this paper, only the psychological consideration factors will be discussed[1]. It should be mentioned that one of the general inclusion criteria is that the psychological screening has not elicited any contraindications. With regard to the 'psychological consideration factors', the ACC argues that there might be an association between high levels of depression and poor coping strategies with poorer SCS-outcome, but that these factors do not exclude people from SCS (Stephenson, 2016). Therefore, psychological testing should not be used to predict SCS-outcome. The ACC and The British Pain Society both emphasize that psychological assessment does not in itself predict a successful SCS-outcome However, it can be used to identify those candidates who are at risk of a poorer SCS-outcome, so that they can be carefully considered and monitored. This might result in SCS being deferred or cancelled. Exclusion criteria described by the ACC include the following: a history of escalating medication reliance, poorly controlled psychosis, emotion regulation problems, major depression, active suicidal behavior or untreated self-harm behavior, untreated alcohol or drug

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[1] The whole guideline can be found on: https://www.acc.co.nz/assets/provider/ACC7914-Guidelines-for-neuromodulation-treatment-with-spinal-cord-stimulators-for-pain-management.pdf

dependence or abuse, and major cognitive deficits. The psychological assessment is used primarily to identify psychological factors that may influence the success of SCS (ACC, n.d.).

Until now, the literature has demonstrated that psychological factors might have an important influence in predicting SCS-outcome. However, there is still no clear consensus on the psychological decision-making. As a result, it is difficult to decide how to select the appropriate candidate for SCS treatment. The Diakonessenhuis hospital, located in Zeist, also questioned the extent to which their prediction of a successful SCS-outcome was correct. Their guideline is based on earlier research outcomes, in particular those of the Expert Panel Report on the Psychological Assessment of Candidates for Spinal Cord Stimulations for Chronic Pain Management (Beltrutti et al., 2004).

Beltrutti and colleagues (2004) categorize the inclusion and exclusion criteria into four sections, much like the ACC does. They both state that psychological screening should not elicit any contraindications in the general inclusion criteria. However, their psychological exclusion factors are more expanded from those of the ACC. They included major anxiety and poor anxiety management, personality disorder with functional effect, and overt secondary gain issues, ass psychological exclusion factors. The psychological factors, described in both the ACC guideline and the Beltrutti and colleagues paper, have a cumulative effect on SCS-outcome: the more negative factors, the higher the risk of a poorer outcome. This suggest that it is important to measure a broad range of characteristics during the assessment (Stephenson, 2016).

The Diakonessenhuis uses four psychometric tests for the psychological assessment: the Pain Coping Inventory (PCI), the Illness Cognition Questionnaire (ICQ), the Hospital Anxiety and Depression Scale (HADS), and the Pain Catastrophizing Scale (PCS). The PCI is used to investigate what coping strategies someone uses (Kraaimaat, Bakker & Evers, 1997). The literature has demonstrated that the way in which someone copes with chronic pain, influences their pain experience. The PCI differentiates between active coping strategies and passive copings strategies. The goal of active coping strategies is to tackle the antecedent of the pain, while passive strategies focus on the consequences of the pain. Active coping strategies make the pain more tolerable than passive strategies (Kraaimaat & Evers, 2003). The ICQ focuses on the meaning patients attach to chronic pain. It assesses ways of cognitively evaluating the stressful and aversive character of chronic

illness. Research has revealed that illness cognition can be a mediator between stress and illness. Pain is more bearable when a patient finds a positive meaning in the situation (Lauwerier et al., 2010; Evers et al., 2001). The HADS is a self-report questionnaire which tries to identify symptoms of mood disorders (Bjelland, Dahl, Haug & Neckelmann, 2002). As stated earlier, depression and anxiety are exclusion criteria for SCS. The last inventory is the PCS. The PCS is used to assess the extent to which patients catastrophize, in other words "exaggerate", the pain and the condition they are in. Rosenberg, Schultz, Duarte, Rosen and Raza (2015) demonstrated that patients with greater catastrophizing tendencies were more likely to report lower pain relief, quality of life, and satisfaction after an SCS-implant.

The hospital standard assumes that when no contraindication is found in the psychological assessment, the patient is automatically recommended for an SCS-implant. The recommendation is based primarily on the expertise of the psychologist, and seems to be hardly empirically substantiated. Psychological factors, and the cumulative effects of those factors, are taken into account – as described in Beltrutti and colleagues – but patients with contraindications for the SCS procedure are not excluded. This goes against the ACC guideline. At the Diakonessenhuis, in the case of a contraindication, patients are eligible for general neuromodulation screening, which means they can still receive an SCS-implant even though the general inclusion criteria were not met. This screening, devised by the hospital, is used to indicate what the cumulative effect of the psychological factors might be. Based on the psychometric tests and, in some cases, the neuromodulation screening, the psychologist gives a recommendation for an SCS-implant. Research on the methods used by the hospital is important, since their standard deviates from the ACC guideline. Further insight into the hospital's method is needed in order to establish what influence it has on patients.

The aim of the present study is to examine whether the psychological assessment used by the Diakonessenhuis yields valid information based on which it is possible to make a good prediction on successful SCS-outcome. Two hypotheses arise in the light of the previous findings. The first hypothesis is that the PCI, ICQ, HADS, and PCS all contribute equally to indicate successful SCS-outcome. Since the recommendation, given by the hospital, is based on the cumulative effect of the

psychological tests, the second hypothesis is that the relationship between psychological assessment and successful SCS-outcome is fully mediated by the recommendation given by the psychologist.

Method

Design

This study employs a correlational design. Figure 1 illustrates a conceptual model of the hypotheses. In this research, the concept *SCS-outcome* will be operationalized in two ways. The first one is used by the ACC guideline, in terms of which SCS-outcome is considered successful when the patient experiences an increase of at least 50 percent in pain relief (ACC, n.d., 2012; Cameron, 2004). The second way to operationalize *SCS-outcome* is by means of duration. Since pain is a subjective experience that can change over time (Roditi & Robinson, 2011), the hospital decided to use duration as a measure. When a patient receives SCS for over a year, it is considered successful. The model suggest that all psychometric tests have an equal and significant influence on the recommendation by the psychologist and, by extension, can predict a successful SCS-outcome. As mentioned previously, the recommendation has a mediating function between the psychological tests and SCS-outcome.
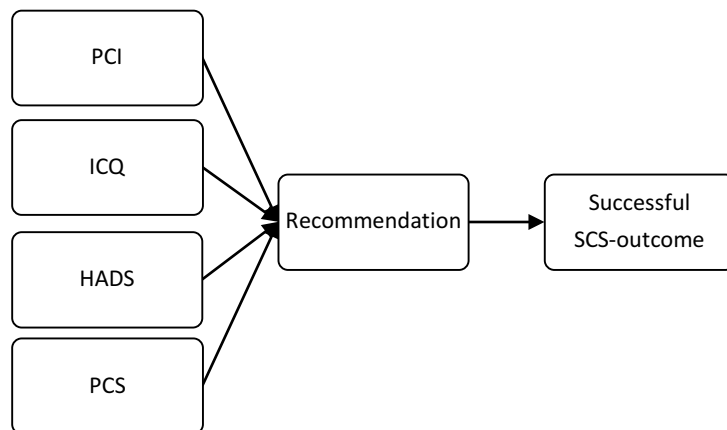

Figure 1. Research design: Recommendation as a mediator for the psychometric tests (PCI, ICQ, HADS, and PCS) and SCS-outcome.

Participants

Retrospective research was undertaken in this study. The scores of the psychometric tests were collected by the hospital and provided for use in this research. The recommendation, SCS procedure,

and SCS-outcome (in duration and pain reduction) were collected from electronic patient dossier (EPD) of the Diakonessenhuis. Moreover, data were collected from daily reports by employing file research. The participants were patients that underwent the SCS-implant procedure between 1 January, 2015 and 1 January, 2017. Within this timeframe, the total number of patients examined amounted to 103. Male (N = 51) and female (N = 52) patients were proportionally divided into separate categories. No other demographic data were collected during this research. There were 33 patients for whom no recommendations were found in the EPD, and in the case of 19 patients it was not clear whether they had gone through with the SCS procedure. Due to these missing recommendations and the lack of information on whether certain patients did or did not receive an SCS-implant, the number of participants was reduced from 103 to 69 patients.

Instruments

Four psychometric tests were used for the psychological assessment. All the questionnaires were in Dutch. Apart from the PCS, none of the psychological tests rendered a total score. A series of factor analyses were conducted for each scale across its test, to establish whether the psychological test would form an overall reliable test. If not, then the the test needed to be divided into several subtests[2]. The PCI indexes the coping strategies employed by patients with chronic pain. The questionnaire consisted of 33 items and could be answered on a four-point Linkert scale (1 = rarely or never, 2 = somewhat, 3 = often, 4 = really often). The test consisted of six separate scales that could be divided into active and passive coping strategies. Pain transformation, distraction, and lowering demands are regarded as active coping strategies, while pulling back, ruminating, and resting are regarded as passive coping strategies. (Spelthann, Jungen & Bokhorst, 2013). An example statement is: "I rest by sitting down or lying down". The inventory has no total score (Spelthann, Jungen & Bokhorst, 2013). A factor analysis of the PCI revealed a two-factor solution. The two factors cumulatively accounted for 55,1% of the variance. The PCI can be divided into PCI-passive coping strategies and PCI-active coping strategies, similar to what is encountered in the literature (Spelthann, Jungen & Bokhorst,

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[2] The internal reliability of a subscale couldn't be measured, because the scores of the individual items weren't known.

2013). The reliability of PCI-active coping strategies is regarded as unacceptable (α = .40). The reliability of PCI-passive coping strategies is slightly higher, but still considered questionable (α = .65)[3].

The ICQ assesses three ways of cognitively evaluating the stressful and aversive character of chronic illness: helplessness, perceived benefits and acceptance (Lauwerier, Crombez, Damme, Goubert, Vogelaers & Evers, 2010). The questionnaire consisted of 18 items to be answered on a four-point Likert scale (1 = not at all, 2 = somewhat, 3 = to a large extent, 4 = completely) (Evers, Kraaimaat, Lankveld, Jacobs & Bijsma, 1998). An example statement is: "I can cope effectively with my illness" (Evers & Kraaimaat, 1998). The questionnaire does not have a total score (Evers et al., 1998). A factor analysis of the ICQ demonstrated a one-factor solution which accounted for 65%[4]. The reliability is acceptable (α = .73). This indicates that the test provides an acceptable indication of the meaning that people assign to their chronic pain.

The HADS measures symptoms related to anxiety and depression. The questionnaire consisted of 14 items on a four-point Likert scale, and the answers were dependent on the statements (Jungen & Bokhorst, 2012). For example, to the statement "I feel tense or wound up", patients could answer: not at all (0), from time to time (1), a lot of the time (2), or most of the time (3); while to the statement "I look forward with enjoyment to things" they could answer: as much as I ever did (0), rather less than I used to (1), definitely less than I used to (2), or hardly at all (3) (St. George's, 2019). The questionnaire had no total score (Jungen & Bokhorst, 2012). A factor analysis on the HADS revealed a one-factor solution which accounted for 83,8% of the variance. The reliability is good (α = .81). This indicates that the test provides a good indication of the emotions and complaints by patients over the course of one full week.

The PCS is a self-assessment questionnaire used to measure the extent to which patients catastrophize their circumstances. The questionnaire consisted of 13 items to be answered on a five-point Likert scale: (0 = not at all, 1 = to a slight degree, 2 = to a moderate degree, 3 = to great degree,

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[3] Crombach's alpha must be interpreted carefully since factor analysis where conducted for each scale across the test to establish an overall test, instead of on the items to establish a subscale.

[4] The subscale helplessness is recoded.

4 = all the time). The test had three subscales: rumination, helplessness, and magnification. The total score was calculated by adding up all the scores (Swinkels, van Engelen, Bokhorst, 2016). An example statement is: "I feel I can't go on" (Sullivan, 1995). The factor analysis on the PCS revealed a one-factor solution which accounted for 77,9% of the variance. The reliability is good (α = .84). This indicates that the test provides a good indication of how people catastrophize.

In addition to the psychometric test, the recommendation is also a factor in the research design and functions as the mediator between the psychometric tests and the SCS-outcome. A positive recommendation was indicated as a yes (0). A dubious recommendation was indicated as an intervention (1), because the hospital recommends a different intervention before SCS. When SCS was not recommended, it was indicated as a no (2). SCS success was measured by duration and pain reduction. The scores for duration were shorter than a year (0), longer than a year (1) or does not apply (2). The scores for pain reduction were less than 50% (0), more than 50% (1), or does not apply (2). The "Does not apply (2)" category was subsequently filtered out. The variable SCS procedure was added to the analysis to establish whether the patient went through with the SCS procedure and how many patients backed out of the procedure. SCS procedure was scored with a yes (0) when a patient received the SCS-implant, and with a no (1) when a patient did not receive the implant.

Statistical Analysis

To test the hypothesis that the PCI, ICQ, HADS, and PCS all contributed equally and significantly to a successful SCS-outcome, a logistic regression was conducted. To test the second hypothesis – namely that the relationship between the psychometric tests and a successful SCS-outcome was fully mediated by the recommendation given by the psychologist – a mediation analysis was performed.

The psychometric tests were independent variables, and recommendation was the mediator variable. SCS-outcome was a dependent outcome with two outcome measures; 1) duration and 2) pain reduction were considered to be separate outcome measures. First, a logistic analysis was performed to test the relationship between psychometric tests and SCS-outcome. Second, the relationship between the psychometric tests and recommendation was tested through multiple regression. Thereafter, another logistic regression was performed between recommendation and SCS-outcome. A significant

relation between recommendation and the psychometric tests, and recommendation and SCS-outcome, is essential to consider the recommendation as a mediator. The last step was therefore logistic regression, to test the model with the psychometric tests in block 1 and recommendation in block 2. The assumptions for logistic regression and multiple regression – linearity, independent of errors, and absence of multicollinearity – were met (Filed, 2013).

Results

The normscores used by the hospital for the psychometric tests were not retrievable in the literature and were therefore not used in this research. The mean values, standard deviations, number of questions per questionnaire, and the minimum and maximum score per questionnaire are presented in Table 1. A total of 69 patients were included in the analysis. The HADS is one patient short; this is due to the fact that one patient did not fill in the HADS, but did fill in the rest of the tests.

Table 1
Descriptive of the psychometric tests

	N	No. qn.	*Min*	*Max*	*M*	*SD*
PCI - active	69	12	12	48	27,6	5,5
PCI - passive	69	21	21	84	48,1	10,8
ICQ	69	18	18	72	33,7	9,9
HADS	68	14	0	42	14,8	7,6
PSC	69	13	0	52	28,2	12,0

Note. N = number of patients; No. qn. = number of questions in the questionnaire; *M* = mean value; *SD* = standard deviation; *Min* = minimum (raw) score; *Max* = maximal (raw) score

All the tests correlated significantly with each other, with the exception of PCI-active. PCI-active only correlated significantly, but weakly, with the ICQ, $r = .258$, $p = < .05$. PCI-passive, however, correlated positively with the HADS ($r = .6$, $p < .01$), PSC ($r = .653$) and negatively with ICQ, $r = -.588$, $p < .01$. This means that patients who use passive coping strategies are more likely to experience depression and anxiety symptoms and to catastrophize, and less likely to use positive cognitive evaluations. It is notable that PCI-active and PCI-passive do not correlate with each other $r = .031$, $p > .363$. This demonstrates that the use of passive coping strategies does not say anything about the use of active coping strategies and vice versa. The results also revealed the significant relation between the

ICQ and the other tests, which means that the more positive cognitive evaluations patients have, the less likely they are to report depression and anxiety symptoms and to catastrophize. It also seems that these patients make less use of passive coping strategies and more of active coping strategies.

Table 2
Pearson correlation between the psychometric tests

	PCI – active	PCI - passive	ICQ	HADS	PCS
PCI - active	-				
PCI - passive	.031	-			
ICQ	.258*	-.558**	-		
HADS	-.178	.600**	-.739**	-	
PSC	-.052	.653**	-.597**	.655**	-

*Note. * p < .05; ** p < .01*

Table 3 indicates how many patients received a recommendation for SCS after a psychological assessment and how many patients actually went through with SCS. Approximately 75% of the patients received a "yes" recommendation, which means they could continue with the SCS procedure and receive the implant. Of these 52 patients, only 40 actually went through with the implant. Thirteen of the patients received a recommendation first to undertake a different type of intervention before undergoing SCS. Half of them went through with the implant. Only four patients were strongly advised not to undergo SCS after the psychological assessment. One of the four managed to undergo SCS.

Table 3
Recommendation for SCS-implant

		SCS-implant		
		Yes	No	Total
Recommendation	Yes	40	12	52
	Intervention	7	6	13
	No	1	3	4
	Total	48	21	69

As mentioned earlier, the way the hospital operationalizes the concept "SCS-outcome" differs from what is encountered in the literature. Table 4 illustrates the extent to which SCS-outcome in duration

and SCS-outcome in pain reduction match. Less than one year of SCS and pain reduction of less than 50% are regarded as a match; while longer than one year of SCS and pain reduction of more than 50% of pain reduction are regarded as a match. The total of patients is reduced to 51 due to missing information. Table 4 indicates that 35 patients count as a match, and 16 patients deviate from this "ideal situation". Thirteen of the 45 patients who received SCS for over a year describe a pain reduction of less than 50%.

Table 4

Number of patients experiencing SCS success in duration and pain reduction

		Pain reduction		
		< 50%	> 50%	Total
Duration	< 1 year	3	3	6
	> 1 year	13	32	45
	Total	16	35	51

Mediator Analysis

The mediator analysis starts with a logistic regression, which was performed to determine whether the PCI-active, PCI-passive, ICQ, HADS, and PCS predict SCS-outcome in duration. None of the psychometric tests significantly predicted SCS duration (with the exception of PCI-passive, Wald $Z < 0.69$, $p > .45$). The results demonstrate that PCI-passive gives the strongest prediction for SCS-outcome in duration (Wald $Z = 2.755$, $p = 0.097$), but is also not significant.

Another logistic regression was performed to determine whether the PCI-active, PCI-passive, ICQ, HADS, and PCS predict SCS-outcome in pain reduction. In this analysis, too, none of the psychometric tests significantly predicted SCS-outcome in pain reduction. The strongest predictors of pain reduction were the ICQ (Wald $Z = 2,769$, $p = .07$) and the HADS (Wald $Z = 3,279$. $P = .096$).

The results, presented in Table 5, demonstrate that the psychometric tests give a slightly better prediction of pain reduction than duration. It must be pointed out this outcome should be interpreted very carefully, since the results are non-significant. All in all, the hypothesis that the psychometric tests contribute equally to a positive SCS-outcome is rejected.

Table 5

Outcome logistic regression - the psychological tests predicting SCS-outcome in duration and pain reduction

	SCS-outcome Duration		SCS-outcome Pain Reduction	
	Wald's Z	*p*	Wald's Z	*p*
PCI - active	.069	.793	1.467	.226
PCI - passive	2.755	.097	1.583	.208
ICQ	.384	.535	2.769	.096
HADS	.155	.693	3.279	.070
PSC	.570	.450	1.388	.239

A multiple regression was performed to analyze whether the psychometric tests add a predictive value for recommendation. The results presented in Table 6 demonstrate that none of the psychometric tests significantly predict recommendation. The PCI-passive turned out to give the strongest prediction for recommendation (b* = .411, *p* = .072). This might mean that the recommendation relies primarily on the outcome of PCI-passive, but since the results are not significant this must be interpreted very carefully.

Next, a logistic regression was performed to analyze whether recommendation has a predictive value for successful SCS-outcome. The result revealed that recommendation does not significantly predict either SCS-outcome in duration (Wald's Z = .026, *p* = .873) or SCS-outcome in pain reduction (Wald's Z = .629, *p* = .428). As all effects related to the proposed mediator – recommendation – proved to be non-significant, no further mediation analyses were conducted. The hypothesis that "the relationship between psychological assessment and successful SCS-outcome is fully mediated by the recommendation" is rejected.

Table 6

Outcome multiple regression - psychological test predicting recommendation

	SCS-outcome Duration	
	Beta Coefficients	*p*
PCI - active	-.022	.897
PCI - passive	.411	.072
ICQ	-.164	.543
HADS	-.093	.718

Discussion

SCS has been used for decades to reduce chronic pain (The British Pain Society, 2009). Even though research revealed the influence of psychological factors on SCS-outcome, there is still no consensus on the usage of a psychological assessment. Due to lack of clarity the Diakonessenhuis questioned the way it was using their psychological assessment. The aim of the present study is to examine whether the psychological assessment, used by the Diakonessenhuis, yields valid information based on which it is possible to make a good prediction on successful SCS-outcome.

The findings rejected the first hypothesis "the PCI, ICQ, HADS and PCS all contribute equally to indicate SCS-success". The results demonstrated no significant correlation between the psychometric tests and SCS-success in either duration or pain reduction. This means that the psychometric tests do not predict a successful SCS-outcome. This result is partly divergent from the literature. Even though the literature does not describe specific psychometric tests that should be used for the psychological assessment, it does mention the psychological factors that might significantly influence successful SCS-outcome. Anxiety, poor coping abilities (Celestin, Edward & Jamison, 2009 in Blackburn et al., 2016; Stephenson, 2016), depression (Sparkes, Raphael, Duarte, LeMarchand, Jackson & Ashford RL, 2010 in Blackburn et al., 2016; Stephenson, 2016) and cognitive impairments (Atkinson et al., 2011 in Blackburn et al., 2016) are all associated with poor SCS-outcome. These psychological factors are tested through the PCI, ICQ, HADS and PCS.

Looking at the strength of the relationships between the psychometric tests and successful SCS-outcome, the results do seem to suggest that pain reduction might be a more precise measurement for successful SCS-outcome. This is in line with the literature. Cameron (2004) states that SCS-outcome is considered successful when a patient experiences a reduction in pain of at least 50%. However, it must be noted that this result in entirely non-significant. Future research is needed with a view to testing this hypothesis directly.

The findings also reject the second hypothesis, namely that "the relationship between psychological assessment and successful SCS-outcome is fully mediated by the recommendation given by the psychologist." No correlation was found between the psychometric tests and recommendation and between recommendation and successful SCS-outcome. This raises the question

on what variables the recommendation is based, and how these variables are related to successful SCS-outcome. It is known that when there are contraindications in the psychometric tests, the hospital performs a neuromodulation screening. Further research is required in order to gain a better understanding of the screening as a whole. Since no relation has been found between recommendation and successful SCS-outcome, it is likely that neuromodulation screening is not a reliable way to predict successful SCS-outcome. Another variable that might influence the recommendation is the subjective perspective of a psychologist. The Diakonessenhuis does not use the contraindications in the psychometric tests as an exclusion criterion, but as a criterion to be especially sensitive to the cumulative effects of the psychological factors. It could be the case that the hospital's subjective view overrides the hard numbers.

Looking at the number of patients who actually went through with the SCS-procedure, after a positive recommendation (ass revealed in table 3), it should be noted that approximately a quarter of the patients who received a positive recommendation for an SCS-implant, and half of the patients who received a recommendation to undertake a different intervention first, did not go through with the procedure. It might be interesting to investigate why this is the case. The results might reveal a joint variable that prevents (or even excludes) patients from undergoing SCS. Were such factors to become apparent, they could contribute in the development of general inclusion and exclusion criteria.

Recommendations

With regard to follow-up research, one could recommend that this research be redone on a larger scale and with a stronger design; however, there have been new developments in the field of psychological factors in relation to SCS. Recent research has demonstrated that emotional intelligence can be used as predictor of SCS success (Doherty, Walsh, Andrews & McPherson, 2017). Emotional intelligence is described as "a term which refers to the ability to identify and manage emotions in oneself and others and has been shown to be inversely associated with emotional distress and acute pain." The recommendation for follow-up research is therefore to test whether emotional intelligence has a predictive effect on SCS-outcome.

Strengths and Limitations

A strength of this correlation study is that the data are based on patients that naturally had chronic pain and underwent the SCS procedure. On the other hand, relatively scant demographic data were gathered – only data relating to gender – which makes it difficult to generalize the results. Moreover, the results should be interpreted carefully, due to several limitations. First, the sample size turned out to be very small, due to missing information. Second, there was little variability in the recommendations. This one-sided image of the recommendation might have influenced the correlation with the other variables, and might explain why it lost his mediating function. Another limitation is that dichotomous outcome measures where used. It might be that a lot of information got lost because of this. The lack of variability might have affected the power of the study and could be the reason in why there is no statistical differences detected.

Conclusion

It can be concluded that there is too little evidence to assume that the psychological assessment, used by the Diakonessenhuis, gives valid information on which it is possible to make a good prediction on successful SCS-outcome. The assessment can be used to monitor which psychological factors the patient struggles with and what their cumulative effect is. It can also be used to predict what intervention a patient might need. The involvement of a psychologist is desirable, but does not give a predicted value for successful SCS-outcome.

Practical Implications for Diakonessenhuis

This research was conducted in collaboration with the Diakonessenhuis. The results of this study have demonstrated that the psychological assessment used by the Diakonessenhuis does not yield valid information to make a good prediction on successful SCS-outcome. The hospital's psychological assessment seems rather to fit the role that The British Pain Society (2009) and the NICE (2009) ascribe to the psychologist in the SCS procedure: "the psychologist has a supportive function during the SCS procedure (pre- and post-operation) and monitors the psychological state." To have a more predictive value, it is recommended that the hospital implement the ACC guideline (n.d.; 2012) and, in

particular, make use of the diagnostic summary. It should be noted that the ACC clearly states that the psychological assessment on its own does not predict SCS success, but does give insight into the (cumulative) psychological factors. Following a protocol makes the data more objective and measurable, and follow-up research would certainly benefit from this. It is further recommended that successful SCS-outcome be measured not only in duration, but also in pain reduction on a visual analogue scale (VAS-score). In the light of recent research, one suggestion could be to include a test that measures emotional intelligence. With regard to the amount of missing information in this research, the importance of a systematical register must be stressed. Both quantitative data and qualitative substantiation are useful for future research.

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