Retrospective Study

Disability Pension Did Not Reduce Opioid Use Among Patients With Failed Back Surgery Syndrome Who Were Trialed and Implanted for Spinal Cord Stimulation

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Background: Spinal cord stimulation (SCS) is an effective treatment for failed back surgery syndrome (FBSS). In patients with FBSS, opioids have often been initiated, even before SCS is trialed.

Objective: We studied the effect of retirement on opioid use in patients with chronic pain after failed back surgery.

Study Design: A retrospective study design.

Setting: The study was conducted at Kuopio University Hospital.

Methods: The study group consisted of all 230 patients with SCS trialed or implanted for FBSS at Kuopio University Hospital Neurosurgery from January 1, 1996 through December 31, 2014. All purchases of prescribed opioids and their daily defined doses, as well as data on working ability, were obtained from the Social Insurance Institution. Patients were divided into 3 groups: SCS trial only, SCS implanted permanently, and SCS implanted but later explanted. We analyzed the differences in opioid use among these groups 2 years before and 2 years after the start of their disability pension (DP).

Results: During the follow-up period, a total of 60 patients received a DP. One year before DP, the majority of patients used opioids (n = 43, 72%), and throughout the one-year follow-up after retirement, the number of users increased slightly (n = 46, 77%). In the permanently implanted SCS group, the number of strong opioid users decreased after retirement. Most patients used a moderate dose (0.1–10.5 morphine milligram equivalent/d). Retirement appeared to interrupt dose escalation in all groups, but doses increased further as the follow-up continued.

Limitations: No structured questionnaires were used in this study. Also, many underlying factors contributing to chronic pain were missing.

Conclusions: DP did not reduce the use of opioids in patients with FBSS. Opioid doses were lower and dose escalation less steep with continuous SCS therapy.

Key words: Failed back surgery syndrome, spinal cord stimulation, opioids, retirement, disability pension

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Low back pain is one of the most common pain conditions in the world, resulting in significant use of health care services and causing substantial socioeconomic burden due to the cascade of medical costs related to treatment, sick leaves, and disability pensions (1). In addition, the use of surgery for low

back pain-related symptoms has increased significantly in recent years (2). The estimates of persistent postoperative pain, also known as failed back surgery syndrome (FBSS), have remained reasonably constant over the years within the range of 10% to 40% (3), with the most recent projections being around 20% (4,5).

With its complex nature, the treatment of FBSS has been recommended to be multidisciplinary and includes the optimization of medical management and nonmedical conservative treatment options (6,7). With regard to pharmacological treatment, the use of opioid analgesics is common with patients who have FBSS (8). However, in recent years, recommendations for the use of opioids, both in general and in cases of FBSS, has veered toward suggesting very careful patient selection for opioids use, and even the discouragement of long-term use of opioid treatment (9-11).

For patients experiencing more severe symptoms due to FBSS, a treatment exhibiting both cost-effectiveness and satisfactory symptom relief in selected patients has been spinal cord stimulation (SCS) (12-14). In earlier studies, permanent SCS use has been associated with reductions in sick leave and disability pensions (15), but the results from different studies, especially with respect to return-to-work status, vary considerably (16-18). SCS has also been linked to a reduction in opioid treatment (19,20).

The effect of retirement on opioid use has not been previously studied. The purpose of this study was to investigate 1) the prevalence and dosing of opioids in retiring patients with FBSS, 2) the effect of SCS treatment on opioid doses before and after a disability pension was received, and 3) whether receiving a disability pension affects the dosage or use of opioids.

Methods

The study group consisted of 230 consecutive patients with FBSS who were trialed or implanted with SCS at Kuopio University Hospital (KUH) Neurosurgery from January 1, 1996 through December 31, 2014. KUH is a publicly funded nonprofit hospital. The medical charts and added data from national registers were retrospectively evaluated. A neurosurgeon, orthopedic surgeon, or pain physician who also provided the primary treatment, such as physical therapy and oral analgesics, diagnosed the FBSS cases. The decision to try an SCS device (trial period) was made by a neurosurgeon after a polyclinic evaluation. Patients had received at least one lumbar disc or decompression operation but nevertheless suffered from radicular lower limb pain or combined lumbar pain.

The SCS paddle-lead electrode (Resume 3586, Specify 2x4 3998, or Specify 5-6-5 39565, Symmix 3982, Medtronic) was implanted into the epidural space microsurgically under direct visual control. Each patient was under general anesthesia at the time of the procedure. Patients who experienced significant pain relief during a one-week (range 2–15 days) trial period received a permanent internal pulse generator (IPG; model 7425, model 37703, model 7427V, model 37702, or model 97702, Medtronic). Those who did not experience adequate pain relief during the trial period had their electrode removed (SCS trial only).

Patients were divided into 3 groups: SCS trial only, SCS implanted permanently (SCS permanent), and SCS implanted but later explanted due to inadequate pain relief (SCS explanted).

The National Health Insurance (NHI) scheme is a part of the Finland social security system that covers all permanent residents and citizens of Finland. The Social Insurance Institution (SII) of Finland is an independent social security institution that runs the NHI scheme. The SII maintains a nationwide registry of all patients who are or have been retired. The data for disability pension (DP) were derived from the register of the SII. The Finnish statutory pension scheme consists of employment earnings-related and self-employment earnings-related pensions and a national minimum guaranteed pension. Until 2017, the retirement age in Finland was 63 years. After 2017, the retirement age increased steadily. If a disability is prolonged before the actual retirement age, the recipient may be entitled to a DP.

Disability does not automatically justify DP. The ability to work is assessed in relation to work requirements and DP is always the last resort. Before DP all other means are reviewed e.g., vocational rehabilitation. The application for DP is submitted via a physician's statement. An SII medical expert or insurance company determines the fulfillment of DP criteria. The DP is paid by either the pension insurance company or the SII. The SII data on DP from January 1, 1995 through March 31, 2016 were considered for this study. Only granted cases of DP were taken into account.

In Finland, opioids are sold by prescription only. We obtained information on all purchases of prescribed opioids from January 1, 1995 through March 31, 2016, including their defined daily doses (DDD), purchase dates and quantities, Anatomical Therapeutic Chemical classification codes, and refundable purchase records. This information was retrieved from a nationwide registry maintained by the SII. We analyzed the differences

in opioid use among groups in relation to retirement date, which was limited to 3 years (2 years before and one year after the pension). Death information was retrieved from a nationwide registry, maintained by the Population Register Center. The register contains records of all deaths in Finland, for which the causes are always assessed.

During the follow-up, patients used the following opioid preparations: fentanyl transdermal (TD), hydromorphone, methadone, morphine, oxycodone, buprenorphine TD, codeine (with combinations), dextropropoxyphene (this drug was pulled from the US and European markets in 2010), and tramadol. The DDD is a statistical measure of drug consumption defined by the World Health Organization: "The DDD is the assumed average maintenance dose per day for a drug used for its main indication in adults"(21).

To allow for the comparison of opioids, the data obtained from the DDD were converted to morphine milligram equivalents (MMEs). The MME is a value assigned to opioids to represent their relative potencies; it is determined by using an equivalency factor to calculate a dose of morphine that is equivalent to the ordered opioid. To calculate the MME, we used the following conversion factors suggested by the US Centers for Disease Control and Prevention: buprenorphine TD (75), codeine (0.15), dextropropoxyphene (0.2), fentanyl TD (100), hydromorphone (4.0), methadone (3.0), morphine (1.0), oxycodone (1.5), and oxymorphone (3.0) (22-25). The MME conversion factor for fentanyl patches was based on the following assumptions: one milligram of parental fentanyl is equivalent to 100 milligrams of oral morphine, and one patch releases the dispensed micrograms per hour over a 24-hour day period as it is used by the US Centers for Medicare & Medicaid Services (CMS) (26). The MME conversion factor for methadone is used by the CMS when evaluating the Medicare population's opioid use (27).

For the analyses, opioids were divided into 2 groups: strong and weak opioids. Strong opioids included fentanyl, hydromorphone, methadone, morphine, and oxycodone. Weak opioids included buprenorphine, codeine, dextropropoxyphene, and tramadol.

Opioid discontinuation was defined as one or more purchases during the 12 months before retirement but no purchases during the follow-up period of 12 months after retirement. Opioid initiation was defined as one or more purchases during the 12 months after retirement but no purchases 12 months before retirement.

The study protocol was approved by the Institutional Ethics Committee with approval number 27/2014; the data fusion from the national registries was performed with approval from the SII and the Ministry of Social Affairs and Health of Finland.

Statistical Analysis

The demographic data were investigated by calculating the standard deviations and means for the normally distributed variables in addition to the ranges and medians for the other variables. The statistical evaluation was executed with an analysis of nonparametric tests of variance. For categorical outcomes, cross-table analysis and χ^2 tests were used for statistical evaluation. The significance among the groups during the follow-up time was assessed with the negative binomial regression model, and the results are shown as means. P values < 0.05 were considered significant. SPSS 22.0 for Windows (IBM Corporation) was used to perform all statistical analyses.

Results

Study Population

The study group included 230 patients with FBSS. There were 129 patients in the SCS permanent group, of whom 28 (22%) had received a DP during the data collection period. The corresponding figures in the SCS explanted group were 50 and 17 (34%), and in the trial only group, these figures were 51 and 17 (33%) (Fig. 1).

During the follow-up period, 62 patients received a DP. Of these, 55% were women (n = 34). The mean age was 47 years (range 26–65) at the time of implantation and 47 years (range 33–62) at the time of retirement. Most of the patients suffered from both extremity and back pain (n = 41, 66%). The median number of previous lumbar operations before SCS implantation was 2 (range 1–9), and the majority of patients had single-level surgery (n = 35, 58%). Disc herniation (n = 33, 53%) was the most common cause of operation. In the majority of patients (58%, n = 36), retirement was preceded by SCS implantation (Table 1).

In the trial only (n = 10) and SCS explanted (n = 11) groups, 59% and 65% were women, while in the SCS permanent (n = 13) group 46% were women. The mean age was 47 in the trial only and SCS explanted group, and 48 in the SCS permanent group. The median spinal surgery before implantation was 2 in all groups. On average, there were 3 spinal surgeries in the SCS permanent and SCS explanted groups and 2 in the trial only group. Both leg and back pain was suffered 53%

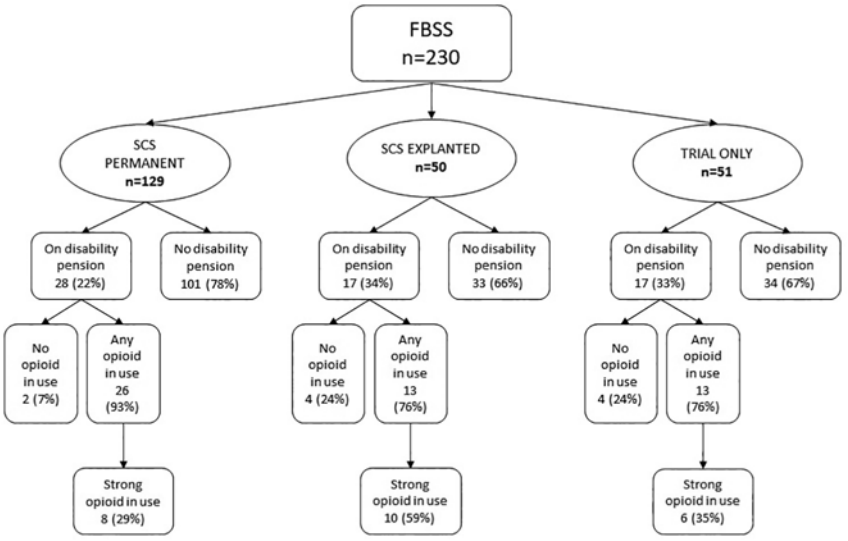

Fig. 1. *Disability pensions of 230 patients with failed back surgery syndrome with spinal cord stimulation and their opioid usage during the follow-up (2 years before and one year after retirement) based on data from the Social Insurance Institute of Finland.*

Table 1. *Demographics of 62 retired patients with failed back surgery syndrome with spinal cord stimulation collected in the Kuopio University Hospital in the period 1996-2014.*

	Trial Only n = 17	Permanent SCS Implanted n = 45		
		SCS Explanted n = 17	SCS in Use at the End Of Follow-up n = 28	
				P
Gender				
Women	10 (59%)	11 (65%)	13 (46%)	0.46
Age on pension date (mean ± SD)	47 ± 6.6	47 ± 8.4	48 ± 6.4	0.94
Location of pain				
Extremity	8 (47%)	6 (35%)	7 (25%)	0.31
Extremity and back	9 (53%)	11 (65%)	21 (75%)	
Number of previous operations before implantation (median/range)	2/1-4	2/1-9	2/1-9	0.89
Level of operation (n = 60)				
L4-5 and above	11 (65%)	2 (12%)	8 (31%)	0.27
L5-S1	2 (12%)	5 (29%)	7 (27%)	
Multiple level	4 (23%)	10 (59%)	11 (42%)	
Reason for operation				
Disc herniation	9 (53%)	10 (59%)	14 (50%)	0.28
Stenosis	4 (23%)	1 (6%)	4 (14%)	
Both	1 (6%)	4 (23%)	9 (32%)	
Other	3 (18%)	2 (12%)	1 (4%)	
Type of electrode[a]				
Symmix/Resume 1x4/Vectris	17 (100%)	17 (100%)	22 (79%)	0.02
Specify 5-6-5/2x4	-	-	6 (21%)	
Pension granted after implantation	13 (77%)	11 (65%)	12 (43%)	0.07

SCS = spinal cord stimulation; [a]all electrodes manufactured by Medtronic.

(n = 9) in the trial only group, 65% (n = 11) in the SCS explanted group, and 75% (n = 21) in the SCS permanent group (Table 1).

Opioid Use in Retirees Regardless of the Time of the SCS Trial

All Opioids

Opioid use was examined over a total period of 3 years (2 years before to one year after the initiation of pension). Of the 62 retired patients, 2 did not have adequate follow-up times after retirement and were excluded from the analysis. Of the remaining 60 patients, 10 did not use any opioids during the follow-up and were therefore excluded from this analysis. The 50 opioid users belonged to the following groups: 12 SCS explanted, 25 SCS permanent, and 13 SCS trial only.

In the SCS permanent group, the mean opioid dose increased moderately toward the end of the follow-up from 8.3 MME/d (95% CI 3.3 to 20.6) at the beginning to 12.6 MME/d (95% CI 6.2 to 25.3) at the end (Fig. 2A).

In the SCS explanted group, as well as in the trial only group, opioid use increased significantly during the follow-up. At the beginning of the follow-up, the mean opioid dose in the SCS explanted group was 11.8 MME/d (95% CI 4.5 to 31.4), and it reached 25.6 MME/d (95% CI 11.7 to 56.0) by the end of the follow-up, with a *P* value < .05. In the SCS explanted group, the mean opioid use was at its highest within 6 months before retirement at 27.2 MME/d (95% CI 11.7 to 63.2) (Fig. 2A)

In the SCS trialonly group, the mean opioid dose at the beginning of the follow-up was 12.9 MME/d (95% CI 6.4 to 26.0). At its lowest, the mean opioid use in the trial group one year before retirement was 12.8 MME/d (95% CI 7.1 to 23.1) and gradually increased thereafter, reaching its highest at the end of the follow-up year after retirement at a mean of 23.9 MME/d (95% CI 12.7 to 45.0), with a *P* value < .05 (Fig. 2A).

Strong Opioids

During the follow-up, 9 patients in the SCS explanted group, 8 patients in the SCS permanent group, and 6 patients in the SCS trial only group used strong opioids. The mean daily MME increased in all groups toward the end of the follow-up. At the beginning, mean daily MME was 14.2 (95% CI 5.0 to 40.7) in the SCS explanted group, 16.6 (95% CI 4.7 to 59.4) in the SCS permanent group, and 17.2 (95% CI 5.9 to 49.9) in the SCS trial only group. The corresponding numbers at the end of the follow-up were 30.2 (95% CI 12.9 to 70.5), 25.5 (95% CI 11.0 to 58.9), and 34.2 (95% CI 14.5 to 80.6), respectively. There were no significant differences among the groups (Fig. 2B).

Weak Opioids

The majority (n = 40, 67%) of patients used a weak opioid during the follow-up. There were 21 (53%) users in the SCS permanent group, 9 (23%) in the SCS explanted group, and 10 (25%) in the SCS trial only group. In the SCS permanent group, the mean opioid use was 3.5 MME/d (95% CI 1.5 to 8.3) 24 months before retirement, and 5.2 MME/day (95%CI 3.1 to 8.9) 12 months after retirement, with a *P* value < .05. In the SCS trial only group, the mean daily use of MME was significantly higher than those in the SCS explanted (excluding the time point 6 months after retirement) and SCS permanent groups (excluding time points 24 and 12 months before retirement) throughout the follow-up period (*P* < .05) (Fig. 2C).

Opioid Use in Retirees with an Implantable Pulse Generator Implanted Before Retirement

Following a one-week trial, an implantable pulse generator (IPG) was implanted in a total of 21 patients (SCS explanted n = 10, SCS permanent n = 11) at a median of 18 months (range 2–126) before retirement. Two patients did not use opioids at all during the follow-up and were excluded from this analysis. A total of 9 patients in the SCS explanted group and 10 patients in the SCS permanent group remained. During the follow-up, a weak opioid was used by 7 patients in the SCS explanted group and 6 patients in the SCS permanent group, while there were 8 strong opioid users in the SCS explanted group and 5 in the SCS permanent group (Fig. 3).

In both groups, the mean daily use of MME was lower at the beginning of the follow-up compared to the end. In the SCS permanent group, the mean opioid use was 14.7 MME/d (95% CI 4.6 to 47.2) 24 months before retirement, whereas it was 14.3 MME/d (95% CI 5.1 to 40.4) in the SCS explanted group. At the end of the follow-up, the corresponding figures were 23.6 MME/d (95% CI 10.4 to 53.7) and 29.2 MME/day (95% CI 12.1 to 70.6). There was no significant difference between the groups (Fig. 3).

Use of Different Opioids Over 2 years (One Year Before to One Year After Retirement)

During the follow-up, 48 (80%) out of 60 patients

used opioids, and for most of these patients, the average dose was low at 0.1–10.5 MME/d. Two patients, both from the SCS permanent group, discontinued opioid use after retirement. Both of them had low opioid use (on average less than one MME/d) during the year before retirement. Five patients started to use opioids after retirement (n = one SCS trial only, n = one SCS explanted, n = 3 SCS permanent). In the year before retirement, 43 (72%) patients used opioids, while 46 (77%) patients used opioids during the year after retirement (Fig. 4).

Oxycodone was the most used of the strong opioids; it was used by 13 (22%) patients during the one year before retirement and by 15 (25%) patients after retirement. Only in the SCS permanent group did the number of users decrease after retirement; 7 patients used oxycodone before retirement and 2 used it after retirement. Two patients from both the SCS trial only and SCS explanted groups started using oxycodone after retirement (Table 2). Of the weak opioids, tramadol was used the most; it was used by 24 (40%) patients

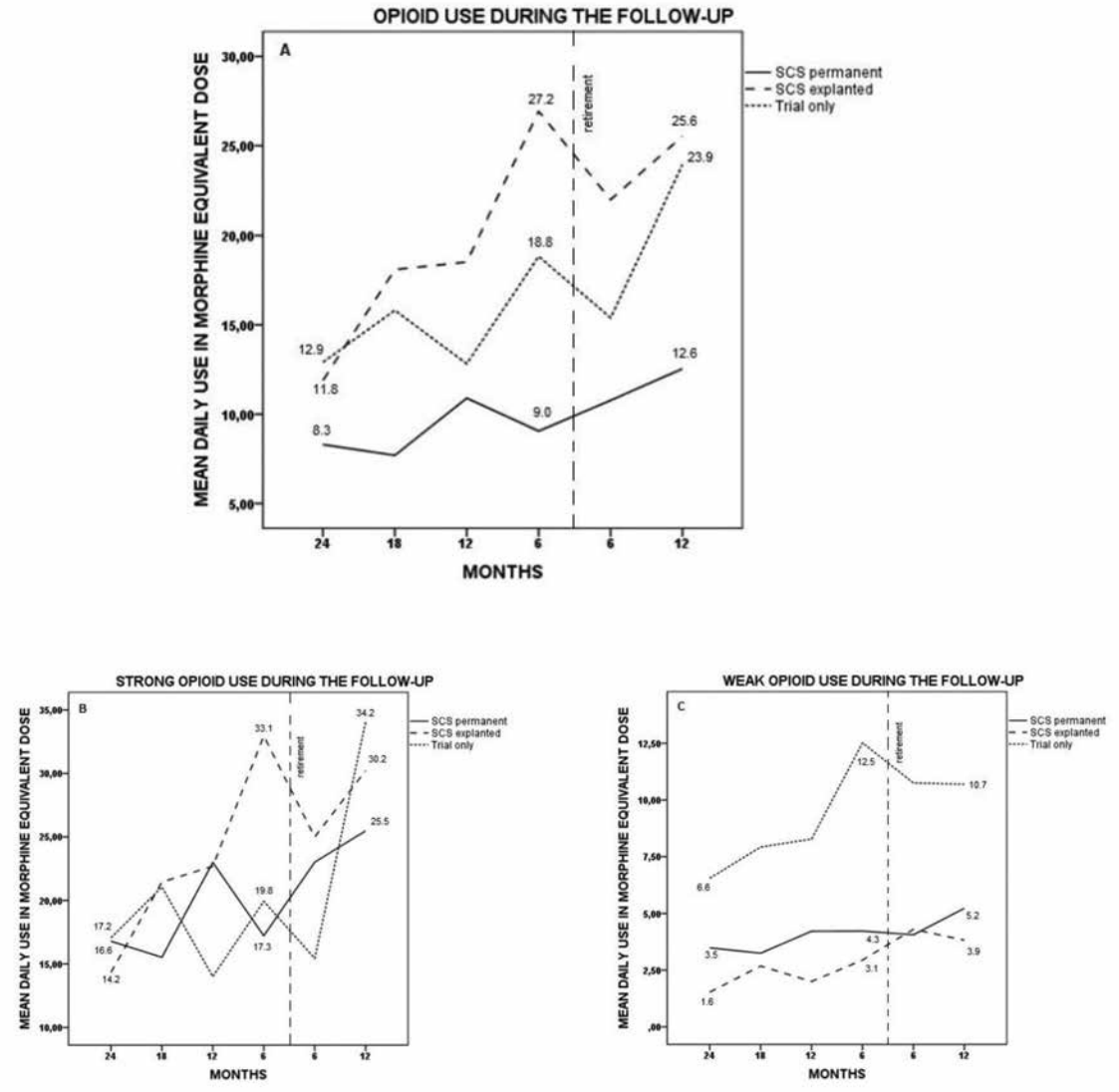

Fig. 2. *Opioid usage in 60 patients with failed back surgery syndrome 2 years before and one year after retirement regardless of the time of the spinal cord stimulation trial period.*

during the one year before retirement and by 28 (46%) patients after retirement (Table 2).

Discussion

This study analyzed opioid use in 60 patients with FBSS with trialed or implanted SCS from 2 years before to one year after receiving a DP. We found that DP appears to have interrupted the dose escalation in all groups, but the doses increased as the follow-up continued. In the SCS permanent group, opioid doses remained relatively low, and the situation remained quite stable regardless of retirement. In the SCS explanted and the SCS trial only groups, the dose increase of opioids was steeper. However, retirement stopped opioid doses from rising in the SCS explanted group.

Opioid use was lowest in the SCS permanent group, where the effects of retirement on doses were also minimal. There were fewer users of strong opioids in the SCS permanent group compared to other groups, and strong opioids were used most in the SCS explanted group. In the SCS trial only group, the doses of strong opioids escalated during the year after retirement.

The number of strong opioid users decreased in the SCS permanent group after retirement. In both the SCS permanent and SCS explanted groups with an IPG before retirement, opioid doses increased toward the end of the follow-up; there were no significant differences between the groups. One year before retirement, the majority (72%) of patients used opioids, and the percentage increased slightly (77%) after one year of follow-up after retirement. Most of the patients used a moderate dose (less than 10.5 MME/d) of opioids both before and after retirement. The SCS trial only group used weak opioids the most; in this group, retirement seemed to cut off dose increases. In both the SCS permanent and SCS explanted groups, the use of weak opioids remained moderate and steady during the follow-up period. The most commonly used opioids were oxycodone and tramadol.

In recent years, more critical attitudes toward opioid treatment have been adopted with the advent of new research. Based on a systematic review and meta-analysis in people with chronic low back pain, opioid analgesics have been found to provide only modest short-term pain relief, and the effect is not likely to be

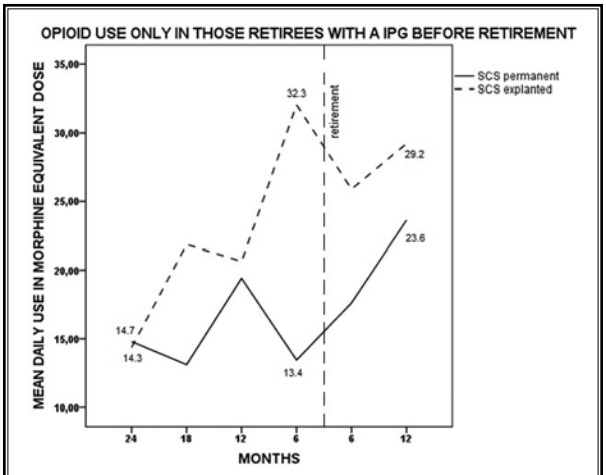

Fig. 3. *Opioid usage in the SCS explanted and SCS permanent groups with an implantable pulse generator (IPG) 2 years before and one year after retirement.*

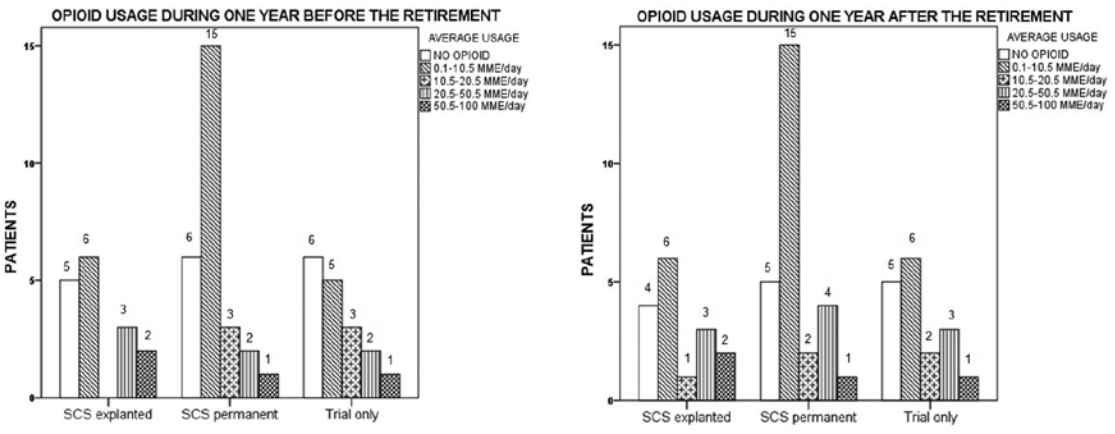

Fig. 4. *Opioid users and doses one year before and one year after retirement.*

Table 2. *Opioid-specific users and mean daily use in morphine milligram equivalent (MME).*

	Trial Only n = 17				Permanent SCS Implanted n = 43							
					SCS Explanted n = 16				SCS SCS in Use at the End Of Follow-up n = 27			
	One year before retirement		One year after retirement		One year before retirement		One year after retirement		One year before retirement		One year after retirement	
Strong opioid	MME (median/ range)	n	MME (median/ range)	n	MME (median/ range)	n	MME (median/ range)	n	MME (median/ range)	n	MME (median/ range)	n
Fentanyl (N02AB03)	27.8/46.5	2	57.0/0	1	9.0/0	1	3.0/0	1	-	0	-	0
Hydromorphone (N02AA03)	0/0	0	-	0	50.3/37.8	2	98.6/0	1	-	0	-	0
Methadone (N07BC02)	-	0	-	0	7.5/0	1	71.3/0	1	-	0	-	0
Morphine (N02AA01)	-	0	-	0	-	0	-	0	2.7/0	1	-	0
Oxycodone (N02AA05)	23.2/7.3	2	24.7/37.3	4	28.3/74.1	4	12.5/24.0	6	16.4/86.2	7	29.3/71.8	5
Weak opioid												
Buprenorphine (N02AE01)	11.4/21.7	2	12.2/9.2	2	3.8/0	1	1.2/0	1	10.3/11.4	3	5.4/21.4	4
Codeine (N02AA59)	0/0	0	0.8/0	1	1.9/2.1	2	1.5/2.8	2	1.7/5.3	5	2.1/3.3	5
Dextropropoxyphene (N02AC04)	14.3/11.6	3	15.4/12.4	2	-	0	-	0	-	0	-	0
Tramadol (N02AX02)	8.7/10.3	6	8.9/11.6	7	2.5/2.9	6	5.7/10.6	6	4.7/9.2	12	3.3/8.5	15

clinically important within guideline-suggested doses (10). A recent systematic review and meta-analysis does not support opioid superiority in chronic non-cancer pain management (28). For the pharmacotherapy of neuropathic pain, strong opioids are only available as third-generation treatment options (29). In this study, the majority of patients used opioids for at least part of the follow-up.

The treatment recommendation for FBSS suggests that a weak opioid be used as a short-term adjuvant treatment if needed, while SCS is recommended to be considered before starting a strong opioid (9). The problem with a strong opioid is the troublesome and widespread side effects (22). In addition, evidence of the long-term efficacy of opioids in the treatment of FBSS-associated chronic pain is lacking.

In this study, several patients used opioids over the long term. Weak opioids were used more often, and while doses remained moderate during the follow-up, there was a slight increase. In contrast, strong opioid doses increased significantly during the follow-up. This could be explained, at least in part, by the development of tolerance. At the same time, for strong opioids, there is no ceiling effect as there is for weak opioids, and this may contribute to the allowance of higher doses. It is possible that doses will increase in a population that does not actively use other pain treatment modalities.

Opioid use in Finland almost tripled from 1995 (about 6 DDD/1,000 inhabitants/d) to 2008 (16.2 DDD/1,000 inhabitants/d) (30). Despite this, in 2008 opioid consumption in Finland was the lowest in the Nordic countries (30). Between 1995 and 2016, the share of opioid users (aged 15–64) in Finland increased from less than 1% to about 7% (31). We want to believe that at least the prescribing of strong opioids for chronic pain conditions is now being approached more rigorously due to increasing knowledge.

Recently, treatment of chronic pain according to the biopsychosocial model has gained more emphasis. In addition, current literature suggests that the intensity of pain and the disability it causes seems to be an independent factor with patients and is more related to depression than the treatment factors (32). It has been shown that a patient with pain suffering from depression and anxiety is more likely to receive opioid treatment at higher doses, for a longer duration, and at a higher risk of side effects than a patient who is mentally better (33). In a follow-up study of patients with chronic pain, depression and alexithymia were associated with higher opioid use compared with those not depressed or alexithymic (34).

Recent research has suggested that an opioid prescription in Finland is more common among those with a low socioeconomic status, which is similar to reports from the United States and the United Kingdom (31). Based on a previous study of the same population, it

has been established that some patients included in this study also have mental and behavioral disorders (15). This could be one explanation for the poor response to opioids.

In a 2011 Norwegian study (35), DP, unemployment, divorce, low income, and low education were associated with persistent opioid use 4 years later. This finding is in accordance with the results of our study showing that DP does not appear to reduce opioid use. Patients' preoperative opioid use has also been found to be a negative predictor of return-to-work rates after lumbar discectomy (36).

This is a retrospective study with evident limitations. Structured questionnaires about quality of life, functional ability, pain, or depression symptoms were not used for this study population. Information on socioeconomic status, education level, working status, income status, and marital status are missing. We also have no information on rehabilitative interventions or other treatments for chronic pain.

This was a long-term follow-up study, and during the time in which it was conducted, the understanding of chronic pain has changed, as have the criteria for permanent SCS implantation. Further, SCS devices and surgical techniques have also evolved. While we were able to obtain information on all opioid purchases, we were unable to rule out opioid abuse based on registry information.

The different groups of the study were formed based on the trial period, whether it had been decided to install a permanent IPG and whether it had been removed at some point later. These groups differ from each other based on initial characteristics, therefore a direct comparison for medication use in relation to DP is challenging. However, the trends of opioid use of patients with FBSS receiving SCS before and after DP is reliable with a retrospective study design. The strengths of this study are its homogenous cohort of consecutive patients with FBSS patients with a long follow-up time. Data on medication use and pensions are from the national prospective register and follow-up without any being lost to follow-up. The analyses were based on medical records and national register data of DP and the national registry of reimbursed medicines for all purchases of prescribed opioids. Retirement and medication use are objective quantities and indicate the patient's functional capacity.

Conclusions

Retirement does not appear to reduce long-term opioid use in patients with FBSS with or without SCS therapy. However, momentarily after retirement, the dose increase appears to reverse in all groups. Patients with SCS in permanent use have also been found to have the lowest opioid consumption rates, both before and after retirement.

Conflicts of Interest

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References

1. Hartvigsen J, Hancock MJ, Kongsted A, et al. What low back pain is and why we need to pay attention. *Lancet* 2018; 391:2356-2367.
2. Martin B, Mirza S, Spina N, Spiker W, Lawrence B, Brodke D. Trends in lumbar fusion procedure rates and associated hospital costs for degenerative spinal diseases in the United States, 2004 to 2015. *Spine (Phila Pa 1976)* 2019; 44:369-376.
3. Wilkinson HA. *The Failed Back Syndrome: Etiology and Therapy*. Springer, New York, NY, 1991.
4. Weir S, Samnaliev M, Kuo T, et al. The incidence and healthcare costs of persistent postoperative pain following lumbar spine surgery in the UK: A cohort study using the Clinical Practice Research Datalink (CPRD) and Hospital Episode Statistics (HES). *BMJ Open* 2017; 7:e017585.
5. Inoue S, Kamiya M, Nishihara M, Arai YP, Ikemoto T, Ushida T. Prevalence, characteristics, and burden of failed back surgery syndrome: The influence of various residual symptoms on patient satisfaction and quality of life as assessed by a nationwide Internet survey in Japan. *J Pain Res* 2017; 10:811-823.
6. Sebaaly A, Lahoud M, Rizkallah M, Kreichati G, Kharrat K. Etiology, evaluation, and treatment of failed back

surgery syndrome. *Asian Spine J* 2018; 12:574-585.

7. Rigoard P, Gatzinsky K, Deneuville J, et al. Optimizing the management and outcomes of failed back surgery syndrome: A consensus statement on definition and outlines for patient assessment. *Pain Res Manag* 2019; 2019:3126464.
8. Anderson JT, Haas AR, Percy R, Woods ST, Ahn UM, Ahn NU. Chronic opioid therapy after lumbar fusion surgery for degenerative disc disease in a workers' compensation setting. *Spine (Phila Pa 1976)* 2015; 40:1775-1784.
9. Gatzinsky K, Eldabe S, Deneuville J, et al. Optimizing the management and outcomes of failed back surgery syndrome: A proposal of a standardized multidisciplinary team care pathway. *Pain Res Manage* 2019; 2019:8184592.
10. Shadeed CA, Maher CG, Williams KA, Day R, McLachlan AJ. Efficacy, tolerability, and dose-dependent effects of opioid analgesics for low back pain: A systematic review and meta-analysis. *JAMA Intern Med* 2016; 176:958-968.
11. Foster NE, Anema JR, Cherkin D, Chou R, Cohen SP, Gross DP, et al. Prevention and treatment of low back pain: Evidence, challenges, and promising directions. *Lancet* 2018; 391:2368-2383.
12. Farber SH, Han JL, Elsamadicy AA, et al. Retrospective review long-term cost utility of spinal cord stimulation in patients with failed back surgery syndrome. *Pain Physician* 2017; 20:797-805.
13. Zucco F, Ciampichini R, Lavano A, et al. Cost-effectiveness and cost-utility analysis of spinal cord stimulation in patients with failed back surgery syndrome: Results from the PRECISE study. *Neuromodulation* 2015; 18:266-276.
14. Bala M, Riemsma R, Nixon J, Kleijnen J. Systematic review of the (cost-) effectiveness of spinal cord stimulation for people with failed back surgery syndrome. *Clin J Pain* 2008; 24:741-756.
15. Kaijankoski H, Nissen M, Ikäheimo T, et al. Effect of spinal cord stimulation on early disability pension in 198 failed back surgery syndrome patients: Case-control study. *Neurosurgery* 2019; 84:1225-1232.
16. Kumar K, North R, Taylor R, et al. Spinal cord stimulation vs. conventional medical management: A prospective, randomized, controlled, multicenter study of patients with failed back surgery syndrome (PROCESS Study). *Neuromodulation* 2005; 8:213-218.
17. Taylor RS, Van Buyten J, Buchser E. Spinal cord stimulation for chronic back and leg pain and failed back surgery syndrome: A systematic review and analysis of prognostic factors. *Spine (Phila Pa 1976)* 2005; 30:152-160.
18. Szmuda T, Słoniewski P, Ali S, Aleksandrowicz K. Does spinal cord stimulation due to failed back surgery syndrome lead to permanent occupational disability? *Neuromodulation* 2020; 23:653-659.
19. Sanders RA, Moeschler SM, Gazelka HM, et al. Patient outcomes and spinal cord stimulation: A retrospective case series evaluating patient satisfaction, pain scores, and opioid requirements. *Pain Pract* 2015; 16:899-904.
20. Nissen M, Ikäheimo T, Huttunen J, et al. Higher preimplantation opioid doses associated with long-term spinal cord stimulation failure in 211 patients with failed back surgery syndrome. *Neuromodulation* 2021; 24:102-111.
21. Defined Daily Dose (DDD). www.who.int/tools/atc-ddd-toolkit/about-ddd
22. Dowell D, Haegerich TM, Chou R. CDC guideline for prescribing opioids for chronic pain – United States. *JAMA* 2016; 315:1624–1645.
23. Controlled substance schedules. www.deadiversion.usdoj.gov/schedules/
24. Miller E. The World Health Organization analgesic ladder. *J Midwifery Women's Health* 2004; 49:542-545.
25. Nielsen S, Degenhardt L, Hoban B, Gisev N. A synthesis of oral morphine equivalents (OME) for opioid utilisation studies. *Pharmacoepidemiol Drug Saf* 2016; 25:733-737.
26. The Centers for Medicare & Medicaid Services. Opioid morphine equivalent conversion factors 2017. www.cms.gov/Medicare/Prescription-Drug-coverage/PrescriptionDrugCovContra/Downloads/Opioid-Morphine-EQ-Conversion-Factors-Aug-2017.pdf
27. Von Korff M, Saunders K, Thomas Ray G, et al. De facto long-term opioid therapy for noncancer pain. *Clin J Pain* 2008; 24:521-527.
28. Busse JW, Wang L, Kamaleldin M, et al. Opioids for chronic noncancer pain: A systematic review and meta-analysis. *JAMA* 2018; 320:2448-2460.
29. Finnerup NB, Attal N, Haroutounian S, et al. Pharmacotherapy for neuropathic pain in adults: A systematic review and meta-analysis. *Lancet Neurol* 2015; 14:162-173.
30. Opioidit pitkäaikaisessa kivussa. [In Finnish] www.fimea.fi/documents/160140/753095/17160_opioidit-opas.pdf
31. Böckerman P, Haapanen M, Hakulinen C, Karhunen H, Maczulskij T. Determinants of prescription opioid use: Population-based evidence from Finland. *Addiction* 2020; 116:170-175.
32. Saariaho T, Saariaho A, Karila I, Joukamaa M. Early maladaptive schema factors, pain intensity, depressiveness and pain disability: An analysis of biopsychosocial models of pain. *Disabil Rehabil* 2012; 34:1192-1201.
33. Howe, CQ, Sullivan, MD. The missing 'P' in pain management: How the current opioid epidemic highlights the need for psychiatric services in chronic pain care. *Gen Hosp Psychiatry* 2014; 36:99-104.
34. Saariaho AS, Saariaho TH, Mattila AK, Ohtonen P, Joukamaa MI, Karukivi M. Alexithymia and depression in the recovery of chronic pain patients: A follow-up study. *Nord J Psychiatry* 2017;71:262-269.
35. Svendsen K, Fredheim OM, Romundstad P, Borchgrevink PC, Skurtveit S. Persistent opioid use and socio-economic factors: A population-based study in Norway. *Acta Anaesthesiol Scand* 2014; 58:437-445.
36. O'Donnell J, Anderson J, Haas A, et al. Preoperative opioid use is a predictor of poor return to work in Workers' Compensation patients after lumbar diskectomy. *Spine (Phila Pa 1976)* 2017; 43:594-602.