



ORIGINAL ARTICLE

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An assessment of the treatment of spinal cord stimulation: Postlaminectomy pain or neuropathic pain

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Abstract

Neuromodulation has a significant place, among the interventional methods, in the treatment of chronic pain. Spinal Cord Stimulation (SCS) is the most applied treatment method among neuromodulation methods. SCS procedure is a neuromodulation method used in the failed back surgery syndrome, neuropathic pain, and cancer pain. The 102 patients who applied SCS were included in the retrospective study from 2017-2022 in the University Algology Department. We asked about pain scores in line with visual analog scale degrees (VAS) before and after the SCS procedure, opioid use and compared the patient satisfaction with the procedure. We divided the patients into two groups as those with a diagnosis of post-laminectomy syndrome (Group 1) and those with a diagnosis of neuropathic pain (Group 2). VAS before SCS was 9.11 ± 0.75 in Group 1 and 8.45 ± 0.77 in Group two. After SCS, the decrease in pain intensity was much more distinct in post-laminectomy patients (Group 1), compared to the neuropathic pain patients (Group 2). The results were as follows: Group 1- 1.98 ± 1.40 , Group 2- 4.08 ± 0.71 , $p < 0.001$. The decrease in using analgesics was observed to be much more significant in Group 2. ($P < 0.05$) Patient satisfaction was higher in Group 1 as well ($p < 0.05$). We hold the opinion that post-laminectomy patients benefit more from the SCS procedure than neuropathic pain patients. We observed that the decrease both in pain intensity and the use of opioid analgesics was statistically and overwhelmingly distinct in post-laminectomy patients. According to the results of our study, we think that SCS is an effective and safe treatment method both for post-laminectomy and neuropathic pain patients.

Keywords: Chronic pain, spinal cord stimulation, post-laminectomy

Introduction

Spinal Cord Stimulation (SCS) procedure is one of the interventional pain treatment methods and is widely applied in the recent years. It is a minimally invasive neuromodulator method applied with a system comprised of implanted electrodes and generators. SCS has an effect mechanism based on easing pain with low voltage electric stimulation applied onto medulla spinalis, thanks to the stimulant electrodes (lead) percutaneously inserted on the epidural space [1-4].

SCS is a frequently applied treatment method in case of various chronic pain such as post-laminectomy syndrome, complex regional pain syndrome, painful neuropathies, refractory angina pectoris, limb pain due to peripheral arterial disease, phantom pain, visceral pain, and post-herpetic neuralgia. During our study, we researched on the effects of MR-compatible SCS application on life quality and its effects on the consumption of

analgesic with patients with the diagnosis of chronic pain after laminectomy surgery and with patients who have neuropathic pain for various reasons.

Material and Methods

In our study, the results of 102 patients who were applied the procedure of MR-Compatible SCS were evaluated in the algology clinic of the university. We have valued the patients as 2 groups, one as post-laminectomy syndrome patients and second as neuropathic pain syndrome patients. The data from the first week after the permanent SCS were assessed.

The examination and operation records during the routine check-ups as well as their file information were inspected. The pain intensities, opioid analgesic medicine uses, satisfaction rates for the procedure applied and the complications of the patients were recorded as study data.

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The demographic data of the patients were recorded as age and sex. Their VAS scores were evaluated as VAS 1-VAS 2 (before and after the SCS procedure). The opioid analgesic use of the patients was evaluated. All of the weak and strong opioid analgesics were identified as the use of opioids. The satisfaction scale for patients has two ranks, satisfied/unsatisfied. The betterment in the daily lives of the patients after SCS procedure was ranked in three steps, more than 50%, less than 50% and no difference.

Technique: In the application of spinal cord stimulation, electrodes are placed in accordance with the painful zones of the patient. Stimulation place correlates with between C3-5 for upper limbs, between T8-10 for back and leg pain, between T12-L1 for ankle and foot. Patients were placed onto the operation table in a prone position and sedated, for the spinal cord stimulation procedure. Local anesthetic injection has been administered into the intervention zone and a small pouch was created for the connecting wires of the electrodes near the incision made in the midline of the intervertebral space. Epidural space was penetrated with a 14G Tuohy/ 16G R-K needle with a paramedian angle close to 45 degrees and checked with scopy imaging. The place where the paresthesia feeling most appropriately covers the painful area of the patient was determined by exposing stimulant and the electrode was fixed under the skin. After the operation, the patients were monitored for 3 hours in the recovery room. The appropriate stimulator settings were made. The patients and their relatives were instructed in detail as to the usage of the device.

Approval for this study was obtained from the Akdeniz University Ethical Committee (Akdeniz University Clinical Research Ethic Committee (25.07.2018-526).

Statistical analysis

Student’s t-test has been used in the analysis of the difference of the mean of age and sex between two groups. For the analysis of the comparisons between VAS 1 and VAS 2 scores, Student’s t-test and Repeated Measure ANOVA tests have been used. For the evaluation of satisfaction rates and use of opioids after intervention, square test has been used. P<0.05 value has been found valid.

Results

During our study, the results of 102 patients who were applied MR-Compatible SCS procedure were statistically evaluated in comparison with one another. 78 patients were treated for post-laminectomy and 24 patients were treated for neuropathic pain (Table 1). 3 of the patients who were diagnosed with neuropathic pain were applied sacral SCS. These patients were those with urinary dysfunction due to spina bifida, with idiopathic urinary dysfunction, and those with anal incontinence complaints due to multiple sclerosis. After SCS procedure, a 50% betterment has been monitored in their complaints. These patients were not statistically taken into consideration. Diagnoses of patients who are in the neuropathic pain group (Group 2) can be seen on Table 2.

Table 1. Demographic data

	Group 1	Group 2	P
Age (Year)	61.76±12.4	50.45±15.5	<0.001*
Cins (Female/male)	53/25	9/15	0.007**

*t-test; **chi square test

Table 2. Distribution of patients in group 2

Causes of neuropathic pain	Number of patients
Injection-induced sciatic nerve damage	1
Nerve damage due to trauma and surgery	3
Brachial plexus injury	3
Spinal cord injury	2
Pain due to polyneuropathy	4
Ischemic neuropathic pain	7
Angina pectoris	2
Phantom pain	2

The patients involved in the study were mostly female (62 females and 40 males). Patients who were in the post-laminectomy group (Group 1) were also mostly female. There were 53 (67.9%) female patients and 25 (32.0%) male patients in this group. As for the patients in the neuropathic pain group, they were mostly males (9 Females, which make up %37.5 and 15 males, which make up %62.5).

The general average age of all the patients was 59.10±13.9. The age average of the female patients was 60.2±13.45 and for males, it was 57.4±14.78. The difference between the ages of males and females

was negligible. (p: 0.32 p>0.05) However, the age difference between the two groups was considerable. In Group 1, the age average was 61.7±12.4, In Group 2, the age average was 50.4±15.5. (p: 0.0001 p<0.05) The age average of the patients from the post-laminectomy group was found to be higher (Table 1).

Pain scores were evaluated before and after the procedure. While the VAS before the procedure was 9.11±0.75 in the patients in the post-laminectomy syndrome group, the VAS in the patients who were applied SCS procedure for neuropathic pain was 8.45±0.77. Pain severity (VAS) was found to be statistically significantly higher in Group 1 (p: 0.0001 p<0.05). When the VAS values after SCS were compared between the two groups, a significant difference was found between the two (p: 0.0001 p<0.05). VAS 2 was found to be 1.98±1.40 in patients in the post-laminectomy syndrome group and 4.08±0.71 in patients in the neuropathic pain group (Table 3). When the VAS values before and after SCS were compared within the group, we found that post-SCS pain scores decreased significantly in both groups (p<0.05). It was determined that the decrease in VAS value after the procedure was much more significant in the group of patients with post-laminectomy syndrome (p<0.05) (Figure 1). With these results, it can be concluded that patients with post-laminectomy syndrome benefit more from the SCS procedure.

Table 3. Pain intensity

Visual Analog Scale (VAS)	Group 1 (n: 78)	Group 2 (n: 24)	p*
VAS 1 (Before SCS)	9.11±0.75	8.45±0.77	0.001
VAS 2 (After SCS)	1.98±1.40	4.08±0.71	<0.001

*t-test

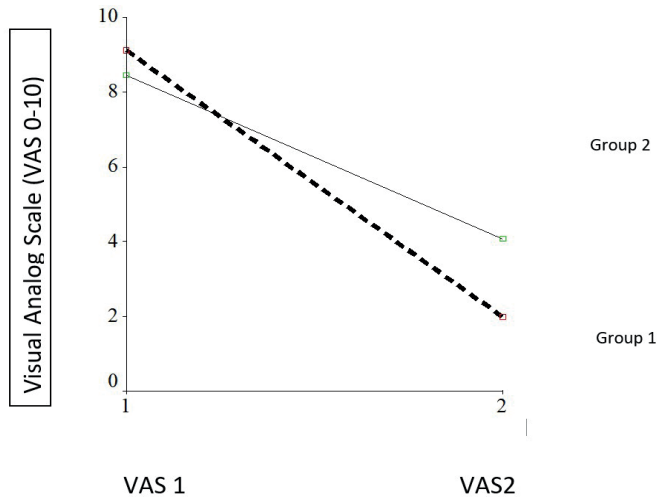


Figure 1. The rate of decrease in pain intensity. *repeated measures ANOVA was performed to show the difference during time between groups: Group 1 had a higher VAS score before SCS (p=0.001) than Group 2 and lower score after SCS (p<0.001) than Group 2

All of the patients in Group 1 who were applied SCS due to post-laminectomy had low back pain and leg pain. Three of the patients in Group 2, who were diagnosed with neuropathic pain, had arm pain. These patients were patients with brachial plexus injury. Two patients complained of chest pain due to angina pectoris. There were ischemic pain complaints in 7 patients. Patients in this group often had lower extremity pain. SCS was applied to these patients because of peripheral vascular ischemia. Opioid use of the patients was evaluated as % (percent). All patients were using opioid analgesics before the SCS procedure. After SCS, 70 (89.7%) post-laminectomy syndrome patients (Group 1) did not use opioids,

while 8 (10.3%) continued to use weak opioid analgesics. In patients with neuropathic pain in Group 2, 8 (33.3%) patients discontinued opioid analgesic use, and 16 (66.7%) patients continued to use opioids. This difference between the two groups was statistically significant (p: 0.0001 p<0.05). It was observed that the use of drugs in the patients in Group 1 decreased more significantly than in the neuropathic pain patients in Group 2. (Table 4). Patient satisfaction was evaluated in two steps as “satisfied/not satisfied”. Patients who reported that they were "satisfied" with the SCS procedure were found to be 73 patients (93.6%) in Group 1 and 11 patients (45.8%) in Group 2. The patients identified as “not satisfied” were 5 patients (6.4%) in the post-laminectomy syndrome group (Group 1) and 13 patients (54.2%) in the neuropathic pain group (Group 2). The difference between the patient satisfaction results of the two groups was statistically significant (p: 0.0001 p<0.05). Since the decrease in both pain intensity and drug use was less in the neuropathic pain group, patient satisfaction was also observed to be low. In all of the patients, successful results were obtained at the end of the trial period and the permanent system was placed. In 11 of the patients we evaluated, revision was made due to the end of generator life and MR-Compatible SCS was inserted. SCS was applied to these patients in 2012, 2013, 2015 and 2016 and revision was made in 2020. The procedure satisfaction of these patients was also found to be 100%. These patients are in Group 1. The improvement in the daily life activities of the patients after SCS was observed. It was observed that the improvement in the daily life activities of the patients was higher in the group of patients with post-laminectomy syndrome (Table 5). There was no statistically significant difference (p>0.05). Complications were seen in only 3 (2.9%) of the patients we applied SCS and included in the study. Complications seen in these patients are incisional infection, electrode migration, and seroma.

Table 4. Opioid analgesic using

Opioid analgesic using	Group 1 n: 78	Group 2 n: 24	p
Pre-SCS	100%	100%	>0.05*
Post-SCS			
Opioid use	8 (10.3%)	16 (66.7%)	0.001*
Opioid not use	70 (89.7%)	8 (33.3%)	

*chi square test

Table 5. Improvement of daily living activity after SCS

Improve	Group 1 (n: 78)	Group 2 (n: 24)
More than 50%*	66	12
Less than 50%	10	10
No change	2	2

*p<0.001 (chi square test was performed)

Discussion

SCS is an effective and safe treatment method in the treatment of severe chronic pain such as post-laminectomy syndrome, various chronic pain syndromes, angina pectoris, and peripheral arterial disease. In our study, the results of 102 patients who were applied MR-Compatible SCS were evaluated. The patients were analyzed as two groups, those with a diagnosis of post-laminectomy syndrome and those with a diagnosis of neuropathic pain, and the results were compared.

Chronic pain in patients with post-laminectomy syndrome is the most common indication for SCS application. In our study, the results of 102 patients who were applied MR-Compatible SCS were evaluated by statistical comparison. 78 of the patients were treated for post-laminectomy syndrome and 24 for neuropathic pain. In the article in which similar patients were reported, the SCS procedure was most frequently applied for patients with post-laminectomy syndrome [5]. In the study of North et al., the results of patients who were applied SCS for pain after low back surgery were reported. Pain relief was more than 50% in 47% of patients who were applied SCS. Patients who had undergone SCS required fewer opioid analgesics [6].

In the studies on SCS, it has been reported that SCS application is one of the effective methods in the treatment of chronic pain [7,8]. In a similar study, it was found that 58% of patients who were applied SCS for chronic low back and leg pain had a significant (>50%) reduction in pain [9].

The most common clinical use of SCS therapy is post-laminectomy syndrome. In addition, SCS is recommended for the treatment of pain in patients with peripheral vascular disease and neuropathic pain such as angina pectoris [10-13].

Most of the patient group (n: 78) we evaluated in our study were patients with post-laminectomy syndrome. The patients we grouped as neuropathic pain were 24. These were patients with severe neuropathic pain with the diagnosis of brachial plexus injury, trauma and injection-related nerve damage, ischemic neuropathic pain, angina pectoris, spinal cord injury. In the study in which the effect of SCS treatment was summarized in patients suffering from pain due to peripheral ischemia, it was reported that patients who received SCS treatment had a lower risk of extremity amputation compared to those who received conventional treatment alone. It has been reported that the quality of life of patients treated with SCS improves and the need for analgesic drugs decreases [14]. In our study, pre- and post-procedural pain scores were evaluated. While the pre-procedural VAS was 9.11 ± 0.75 in the patients in the post-laminectomy group, the VAS was 8.45 ± 0.77 in the patients in the neuropathic pain group. Pain severity (VAS) was found to be statistically significantly higher in Group 1 ($p: 0.0001$ $p < 0.05$). When the VAS values after SCS were compared between the two groups, a significant difference was found ($p: 0.0001$ $p < 0.05$). VAS 2 was 1.98 ± 1.40 in the post-laminectomy group and 4.08 ± 0.71 in the neuropathic pain group. When the VAS values before and after SCS were compared within the group, we found that

post-SCS pain scores decreased significantly in both groups ($p < 0.05$). It was determined that the decrease in VAS value after the procedure was much more significant in patients who were applied laminectomy ($p < 0.05$). In our study, the severity of pain was higher in patients with a diagnosis of post-laminectomy than in patients with neuropathic pain. These patients had multiple drug use together with opioid analgesics. Despite these conventional treatments, it was observed that the severity of pain was very high.

According to our results, it can be thought that the patients in the post-laminectomy group benefited more from the SCS procedure. In this patient group, the decrease in pain intensity after the procedure was observed to be much more significant (Fig 1). When interventional methods are not used in the treatment of chronic pain, long-term use of opioid and nonopioid analgesics is necessary. Multiple drug use and its side effects also disturb patient comfort.

In many studies on SCS application, it has been shown that there is a significant decrease in the use of opioids by patients [15,19].

Opioid use of the patients was evaluated as % (percent). All patients were using opioid analgesics before the SCS procedure. After SCS, 70 (89.7%) of the patients in the post-laminectomy group (Group 1) did not use opioids, while 8 (10.3%) continued to use weak opioid analgesics. In the neuropathic pain group (Group 2), 8 (33.3%) patients stopped using opioid analgesics, and 16 (66.7%) patients continued to use opioids. This difference between the two groups was statistically significant ($p: 0.0001$ $p < 0.05$). In both groups, drug use decreased significantly after SCS. Although the initial pain intensity was high, analgesic use was significantly reduced in patients in the post-laminectomy group. Analgesic use was also decreased in patients in the neuropathic pain group, but not as significantly as in Group 1.

Anxiety, depression, and disruption in social and working life accompanying chronic pain lead to a decrease in the patient's quality of life. Studies on this subject have reported that sleep problems and quality of life improve with the reduction of pain intensity after SCS [20,21]. In our study, the improvement in the daily living activities of the patients after SCS was evaluated. It was observed that the improvement in the daily living activities of the patients was better in the post-laminectomy group.

In patients with chronic pain, patient satisfaction is generally low due to a tiring and wearisome treatment process. It is known that after SCS procedure, the use of analgesic drugs decreases, the severity of pain decreases, and the patient satisfaction increases with the improvement in daily life activities.

In our study, patient satisfaction was evaluated in two steps as "satisfied/not satisfied". Patients who reported that they were "satisfied" with the SCS procedure were found to be 73 patients (93.6%) in Group 1 and 11 patients (45.8%) in Group 2. The patients identified as "not satisfied" were 5 patients (6.4%) in the post-laminectomy group (Group 1) and 13 patients (54.2%) in the neuropathic pain group (Group 2). The difference between the patient satisfaction results of the two groups was statistically

significant ($p: 0.0001$ $p<0.05$).

After the SCS procedure, both pain intensity and drug use were significantly reduced in Group 1, which included post-laminectomy patients. We hold the opinion that patient satisfaction is lower in the neuropathic pain group since the decrease in both pain severity and drug use was also less in this group.

As with many invasive interventional treatment methods, mild or serious complications can be seen in the SCS procedure. It may include early complications such as spinal root or cord damage, dural rupture, infection, and bleeding, which can be seen in epidural implants. The most common complications are wound infection and breakage, separation, and migration of the electrodes [22-25].

In our study, 1 patient had incisional infection, 1 patient had seroma without signs of infection, and 1 patient had electrode migration that did not require intervention. Permanent neurological damage due to SCS procedure was not observed in any patient.

Side effects due to long-term and multiple drug use are common in conventional methods that are frequently used in the treatment of chronic pain. In addition, treatment costs are high. Compared to existing conventional treatments for chronic pain patients, SCS seems to provide a reduction in long-term health care costs, despite significant initial costs. However, studies on efficiency-cost comparisons are insufficient in our country. There is a need for studies comparing conventional and interventional pain treatment costs in accordance with the treatment possibilities of each country.

Conclusion

In our results, as in many studies, it has been shown that SCS application is an effective and safe treatment method in patients with chronic pain. In our study, we found that after SCS intervention, patients' pain intensity decreased and their quality of life increased.

The decrease in pain intensity and opioid analgesic use was very evident after SCS in patients with a diagnosis of post-laminectomy.

We hold the opinion that in patients with persistent radicular pain due to post-laminectomy syndrome, SCS application has much more effective and successful results instead of repetitive operations. As seen in the results of our study, reduction in pain severity, improvement in activities of daily life and patient satisfaction levels support our view.

Conflict of Interests

The authors declare that there is no conflict of interest in the study.

Financial Disclosure

The authors declare that they have received no financial support for the study.

Ethical Approval

Approval for this study was obtained from the Akdeniz University Ethical Committee (Akdeniz University Clinical Research Ethic Committee (25.07.2018-526)).

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