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Percutaneous to Paddle Lead Revision in Spinal Cord Stimulation: A Case Series

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Background: Spinal cord stimulation (SCS) involves the placement of percutaneously placed cylindrical leads or surgically placed paddle leads to deliver electrical stimulation for pain relief. Although more invasive, paddle leads have been associated with less lead migration and revision. We performed a retrospective review of a prospective database of SCS paddle lead implants performed by a single neurosurgeon.

Case Series: Patients were contacted to complete a telephone questionnaire assessing postoperative outcomes. We identified n = 10 patients who underwent replacement of percutaneous SCS with paddle lead SCS. Six patients responded to the questionnaire after an average follow-up period of 37.67 ± 12.72 months. At long-term follow-up, 3/6 respondents reported significant pain relief, and 5/6 respondents reported a decreased need for pain medication.

Conclusions: Comparative outcome data on percutaneous vs paddle lead SCS is limited. Our experience has been that patients who fail percutaneous SCS may be salvaged with conversion to paddle leads with good outcomes.

Key words: Neuromodulation, spinal cord stimulation, failed back surgery syndrome, neuropathic pain, chronic pain, revision surgery

BACKGROUND

Spinal cord stimulation (SCS) is a procedural alternative for chronic pain conditions that persist despite treatment with conservative medical management (CMM) or prior structural surgery. SCS may involve the placement of percutaneously placed cylindrical leads or surgically placed epidural paddle leads to deliver electrical stimulation to the dorsal columns for pain relief (1). Placement of percutaneous leads is typically an outpatient procedure that requires less tissue dissection, which affords a faster recovery time than surgically implanted leads (2). However, percutaneous SCS is associated with higher long-term reoperation rates due to complications, including lead migration and loss of efficacy (2).

Placing paddle leads surgically requires laminotomy to anchor the lead locally, a more invasive procedure (3). However, surgically placed leads are associated with less lead migration and need for revision compared to percutaneous leads (2,7). Additionally, patients with surgically placed SCS systems have greater long-term pain relief (4,7).

To our knowledge, 2 prior studies (3,5) have assessed outcomes of patients who underwent revision from a percutaneous to paddle lead SCS system . Here, we present the characteristics and long-term outcomes of a single-surgeon series of patients with chronic refractory pain syndromes who underwent revision

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surgery. We additionally investigated the influence of previously unreported factors, including the extent of reprogramming and frequency of use of the paddle lead stimulator, that may influence outcomes at long-term follow-up.

METHODS

Institutional Review Board approval was obtained for this study. We performed a retrospective review of a prospective database of patients who underwent surgical implantation of an SCS system by a single surgeon. Ten patients were identified who underwent implantation of a 5-column paddle lead SCS system after removal of at least one percutaneous lead. Patient data on demographic information, percutaneous SCS therapy, reason for SCS revision, and complications of revision surgery were obtained from the medical record (Table 1). Telephone interviews were then conducted at least one year after surgery with a 5-question survey assessing patient outcomes (Table 2). Each patient answered the same set of questions with given responses for each question. The survey questions and response choices are below:

1. How would you describe your current pain relief with SCS? (excellent, good, no change, worse, much worse)
2. How often do you currently use your paddle lead SCS system? (constantly, sometimes, never)
3. Are you satisfied with the results of your paddle lead stimulator overall? (yes, no, unsure)
4. How many times have you had your paddle lead stimulator system reprogrammed? (0-3, 4-6, > 6 times)
5. Has paddle lead SCS helped you reduce your need for pain medication? (yes, no, unsure)

PATIENTS

Case 1

A 69-year-old man presented with chronic pain syndrome characterized by worsening pain that originates in the posterior aspect of the neck and radiates to the occipital region and throughout the head. He was previously evaluated by a neurologist and orthopedic surgeon and tried multiple forms of CMM for pain management, including physical therapy, epidural steroid injections, chiropractic treatment, cervical facet nerve blocks, and Botox injections. Each therapy provided insignificant or transient pain relief while his pain progressed. The patient had multiple back surgeries to additionally treat lumbar pain, which were also unsuccessful. A lumbar SCS implant controlled the lumbar pain, but the head and neck pain was not relieved with a cervical percutaneous SCS system due to 2 previous migrations of the lead (Fig. 1). Therefore, he underwent removal of the percutaneous lead and C2 laminectomy, and surgical implantation of a paddle lead SCS system. The patient initially had good coverage of neck pain and occipital headaches. However, at 15 months after surgery, the patient was no longer using his stimulator

Table 1. Summary of 10 patients who underwent percutaneous SCS lead removal and implantation of a paddle lead SCS system.

Case No.	Age, Gender	BMI	Reason for Conversion	Primary Indication for SCS	Previous Revision	Time With Percutaneous Lead Before Conversion (y)	Percutaneous System Company
1	69, M	23.30	Lead migration	Chronic pain syndrome	Yes	0.21	Medtronic
2	57, M	31.17	Loss of efficacy	FBSS	No	13	Abbott
3	64, M	28.97	Loss of efficacy	FBSS	Yes	13	Medtronic
4	59, W	31.89	Loss of efficacy	FBSS	Yes	4.17	Abbott
5	60, M	33.19	Lead fracture	FBSS	No	2.75	Abbott
6	57, W	19.33	Lead fracture	FBSS	Yes	6.67	Abbott
7	47, W	26.34	Lead fracture	Posttraumatic chronic pain syndrome	No	4	Abbott
8	77, W	34.37	Insufficient pain relief	Nonsurgical back pain	Yes	3	Boston Scientific
9	53, M	35.73	Insufficient pain relief	FBSS	Yes	5	Medtronic
10	76, M	35.37	Insufficient pain relief	FBSS	No	8	Boston Scientific

Abbreviations: SCS, spinal cord stimulation; FBSS, failed back surgery syndrome; M, man; W, woman.

due to lack of pain relief despite reprogramming the system several times (Table 2). The patient was also not using pain medication at this point due to his concern for developing dependence on it with chronic use.

Case 2

A 57-year-old man had a history of low back pain (LBP) previously treated with multiple lumbar surgeries. After an L4-L5 laminectomy and instrumented fusion, the patient had residual pain in the right lower extremity and had a percutaneous SCS system placed. The patient's pain was tolerable for several years with the stimulator before he acutely developed severe LBP. This was only transiently relieved with physical therapy, pain medications, epidural steroid injections, and sacroiliac (SI) joint injections before recurrence of burning LBP radiating to the right lateral lower extremity and foot, and bilateral SI joints. Thirteen years after placement of the percutaneous SCS system, the patient underwent removal of his percutaneous SCS system and T9 laminectomy, and implantation of a paddle lead SCS system. The patient, 2.5 years after surgery, continued to have excellent pain relief with constant use of his paddle lead stimulator and minimal reprogramming (Table 2). Additionally, the patient no longer uses pain medication.

Case 3

A 64-year-old man underwent a left-sided L4-L5 hemilaminectomy and discectomy after developing severe back pain and left L5 radicular pain from an occupational injury. The patient underwent a second surgery for recurrent disc herniation that occurred shortly after the first surgery. He was implanted with a percutaneous SCS system 3 years after the second back surgery due to persistent pain. The percutaneous system provided sufficient pain relief for 9 years before the patient developed distal left lower extremity pain and sympathetic dystrophy in the left foot that persisted after pulse generator replacement. The patient elected to undergo removal of the percutaneous SCS lead and pulse generator and T9 laminectomy, with surgical implantation of a paddle lead SCS system. Approximately 3 years after surgery, the patient reported good pain relief with constant use of his stimulator and minimal reprogramming (Table 2).

Case 4

A 59-year-old woman presented with chronic pain syndrome after multiple cervical and lumbar structural surgeries. The patient was implanted with both cervical and lumbar SCS. The patient received significant pain relief from each stimulator before losing coverage of her pain and undergoing revision of both stimulators. The lumbar stimulator provided sufficient pain relief for 4 years before the patient underwent revision due to loss of efficacy. After revision and additional treatment with high-dose narcotics, the patient continued to have

Table 2. Responses to the phone questionnaire from 6 patients.

Case No.	Q1	Q2	Q3	Q4	Q5
1	Worse	Never	No	>6	Yes
2	Excellent	Constantly	Yes	0-3	Yes
3	Good	Constantly	Yes	0-3	Yes
4	Much Worse	Never	No	0-3	No
5	Good	Constantly	Yes	4-6	Yes
6	No Change	Constantly	Yes	0-3	Yes

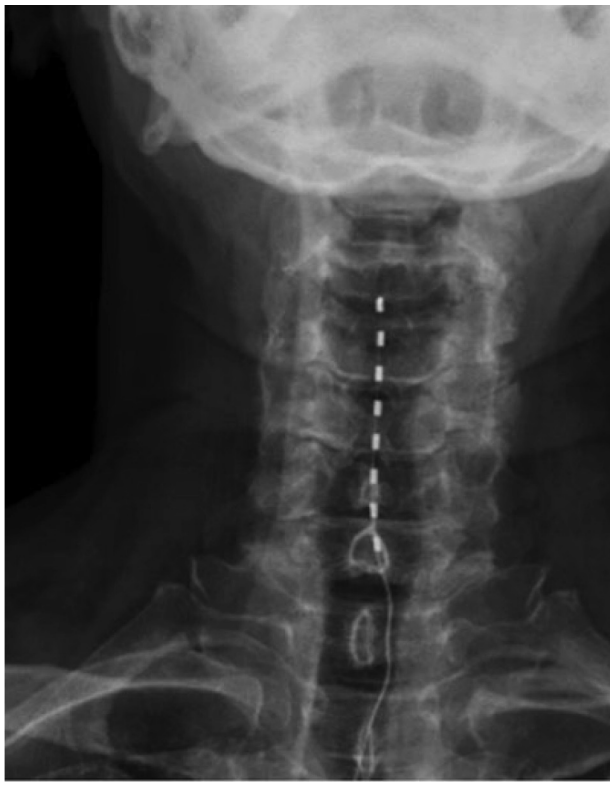

Fig. 1. Preoperative posterior-anterior (PA) spine radiograph showing cervical percutaneous lead migration from C2 in patient 1.

10/10 constant stabbing LBP that radiated down the posterolateral aspect of the bilateral lower extremities to the dorsal feet. Therefore, the patient underwent removal of the percutaneous lead and T9 laminectomy, and placement of a paddle lead with repositioning of the SCS pulse generator. With reprogramming, the patient achieved good coverage of her lower extremity pain. However, the patient presented with chest pain radiating around the chest wall approximately 3 months after implantation of the paddle lead SCS system with a new T7 compression deformity after several falls, necessitating explant of her lumbar stimulator. She reported worse pain at long-term follow-up when she no longer had her stimulator (Table 2).

Case 5

A 60-year-old man underwent an L4-L5 decompression with foraminotomies and an L3-L5 fusion one year later for LBP radiating to the lower extremities. These surgeries initially resolved the patient's pain, but the pain soon returned following the second surgery. The patient then received percutaneous SCS 4 years after fusion surgery with good coverage of his pain. One year after the percutaneous SCS implantation, the patient underwent an L3 laminectomy to extend the previous fusion to L2. Despite multiple structural surgeries and percutaneous SCS, the patient's leg pain below the knees persisted. The patient then underwent removal of his percutaneous SCS system and T9 laminectomy, and surgical implantation of a paddle lead SCS system. Nearly 4 years after surgical SCS implantation, the patient reports good pain relief with constant use of his stimulator and several instances of reprogramming (Table 2).

Case 6

A 57-year-old woman previously underwent lumbar fusion surgery for LBP and left lumbar radiculopathy. Due to persistence of her pain after surgery, the patient underwent implantation of a percutaneous SCS system. Three years and eight months after implantation, the patient had the percutaneous stimulator removed and was implanted with a new percutaneous stimulator due to lead fracture. Sixteen months later, the patient underwent revision of another fractured lead. Six months after this revision, the patient developed an infection at the pulse generator site necessitating stimulator removal. She had the stimulator reimplanted 3 months after removal, but she had a third fractured lead 11 months later, causing loss of coverage. Given several previous revision surgeries and lead fractures, potentially due to the patient's high level of physical activity, the patient elected to undergo removal of the percutaneous lead and T9 laminectomy, and surgical implantation of a paddle lead tunneling to her existing pulse generator (Fig. 2). Eleven months postoperatively, the patient reported modest improvement of symptoms with constant use of her stimulator, one instance of reprogramming, and concurrent physical therapy. The patient, 3.5 years after surgery, underwent no additional reprogramming and reported no significant change in her pain with the paddle lead stimulator. She was able to decrease her use of pain medication and was satisfied with the results of her surgery (Table 2).

DISCUSSION

To our knowledge, only 2 prior studies have investigated outcomes of patients who underwent conversion from percutaneous to paddle lead SCS. A 2014 study by Matias et al (3) reported outcomes in 39 patients that have undergone conversion from percutaneous to paddle lead SCS, 14 of which were diagnosed with failed back surgery syndrome (FBSS). Overall, half of the 39 patients experienced a 3-point reduction in pain after revision and more than half of the patients were satisfied with the results of surgery, which is consistent with the results of our series (3). The FBSS cohort showed no statistically significant difference in results compared to the complex regional pain syndrome (CRPS) cohort of 18 patients. CRPS may be another condition in which patients being treated with percutaneous SCS may benefit from conversion to a paddle lead if they experience loss of efficacy.

Witkam et al (5) studied psychiatric, quality of life (QoL), and medication usage outcomes in 25 FBSS patients who underwent conversion from percutaneous to paddle lead SCS (5). Of note, there was a short-term statistically significant reduction in structural morphine usage and increase in QoL. No significant reduction in medication intake or increase in QoL was found at long-term follow-up (5). However, in our series, 5 of the 6 questionnaire respondents reported a decreased need for pain medication > 1 year after surgery (Table 2).

Additional studies are needed to confirm the effects of conversion from percutaneous to paddle lead SCS on medication usage. Our series showed a potential for a significant portion of patients to be able to reduce their pain medication with paddle lead SCS, which may

increase QoL for patients that fail percutaneous SCS therapy. In a study by Elkholy et al (6) of 34 FBSS patients that received either percutaneous or paddle lead SCS, there was an overall statistically significant decrease in opioid use after SCS implantation. This decrease in opioid use was significantly associated with an increase in QoL (6). Therefore, while some patients may experience direct benefit from a significant additional pain relief after revision from percutaneous to paddle lead SCS, patients that do not experience a significant reduction in pain may still benefit from revision by reducing pain medication usage and increasing QoL.

Limitations

There are several limitations to this study. Its retrospective nature limited the available data that could be included. Additional confounding factors, such as the company of the percutaneous system, could have affected the change in pain relief after revision to paddle lead SCS. Finally, this small sample of patients limits the generalizability of these results to a larger patient population.

CONCLUSIONS

We present the long-term outcomes of 6 patients who underwent revision from percutaneous to paddle lead SCS. Our promising results for patient outcomes warrant further investigation into patient selection for percutaneous vs paddle lead SCS preoperatively, the success rate of revision from percutaneous to paddle lead SCS to reduce the need for reoperation and pain medication, and increase the chance of safe, successful treatment of refractory chronic pain syndromes. Additionally, while revision surgery may be complicated by the presence of scar tissue, no patients experienced neurological complications or infection from surgery.

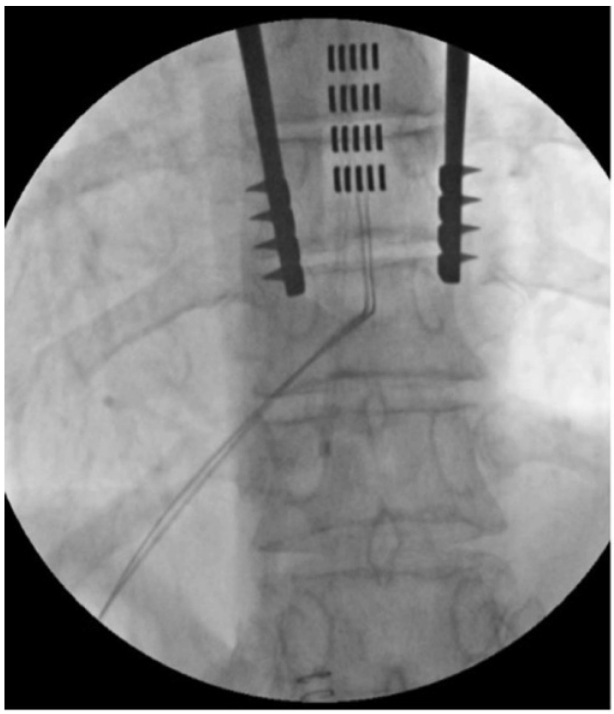

Fig. 2. Intraoperative fluoroscopy image demonstrating T9-T10 placement of the 5-column paddle electrode in patient 6.

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