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Case Report

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New Technique for Replacement of Percutaneous Spinal Cord Stimulation Lead

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Abstract

Migration or malfunction of spinal cord stimulation (SCS) leads is a known complication of which to be aware of neuromodulation therapy. However, the replacement of percutaneous SCS leads is challenging. The following paper presents a new technique that involves inserting a stylet into the previous SCS lead to support the introducer sheath and then replacing a new SCS lead without reinserting spinal needle. This technique is simple, easy to learn and less time consuming when compared to other methods.

Keywords

SCS therapies, SCS lead migration, Percutaneous SCS lead revision

Migration or malfunction of spinal cord stimulation (SCS) leads is a known complication of which to be aware of neuromodulation therapy [1]. The rates of SCS lead migration range from 5% to 21% (with an average 12.2%). The rate of wire breakage is 1.5%. Loss of therapeutic efficacy was observed in 4% of cases (0 to 14%) [2, 3]. The majority of these patients required SCS lead revision or replacement.

Replacement normally involves removing the old leads and inserting new leads. The replacement of percutaneous SCS leads is challenging. It is difficult to place the new leads at the same position of the previous leads. The risk of dural puncture is potentially increased because of the scar formation from the previous SCS implantation [4].

A common replacement technique involves placing an introducer sheath over the old lead. Once the sheath reaches the epidural space, the old lead is removed. Then, a new lead is inserted into the sheath. Insertion of the introducer sheath over the old lead can be very difficult because of multiple reasons:

1. The scar formation surrounding the previous lead can hinder sheath placement.

2. The old lead can become twisted from the courses of anchoring to and passing through lumbar fascial planes such as ligamentum flavum (Figure 1A).

3. The plastic introducer sheath can be too soft to be inserted over the old lead.

4. It can be time consuming when inserting the introducer sheath over the previous lead.

Jeon et al introduced a percutaneous adjustment method to revise transversely migrated spinal cord stimulation leads [5]. A pre-bent guide wire was placed into the epidural space to reposition the SCS lead under the C-arm guidance. However, this technique is only indicated for cases with transversely oriented lead migration, which was implanted short period of time.

Here, we would like to introduce a new technique for replacement of percutaneous SCS leads. This technique is simple, easy to learn, and can be performed without any new instrumentation. It may shorten the lead replacing time and decrease the incidence of dural puncture.

Case Report 1

A 49-year-old female presented with a history of status post of SCS implantation for right flank pain secondary to the kidney surgeries. In the past 9 years, she had received 80% to 90% reduction of flank pain, Numerical Rating Pain Scale (NRPS) from 8-9/10 to 1-2/10, from SCS therapy, until she lost her normal paresthesia coverage of her flank pain. The programing indicated that the 4 of 16 electrodes of two octopolar leads had increased impedance and the implantable pulse generator (IPG) reached its life expectancy. Her X-ray showed no lead migration. It is a challenge of the replaced new leads to cover her small painful area. Based on our previous observation, it was hypothesized that a stylet was inserted into the older lead to reduce twisted curvature, which can provide a firm support to the introducer sheath and make it easily to pass over the old SCS lead into the epidural space (Figure 1). After removal of the old lead, a new lead could easily be inserted through the introducer sheath to the same previous lead location.

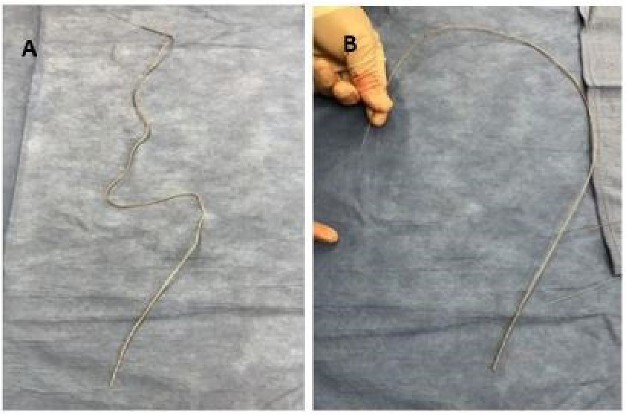

Figure 1: (A)- The lead became twisted and curved after being implanted for years and **(B)**- The twisted lead becomes straight after a style is inserted into the lead.

Procedural technique

The verbal and written consent were obtained. The scars from the previous surgery were marked for incision. The patient was placed in a prone position and given intravenous sedation. The surgical area was prepped and draped in a sterile fashion. The skin was infiltrated with 2% lidocaine with epinephrine. Incisions were made and blunt dissection technique was used to expose both the IPG and leads. After release of the IPG from the scar tissue, the distal portion of the leads was pulled out from the anchor site. The leads were carefully released from the scar tissue and anchors. The leads had become twisted likely due to the previous implantation procedure (Figure 1A). An introducer sheath (Medtronic SCS Replacing Kit. The other SCS company applies a similar device) was inserted over the lead (Figure 2A and 3). A straight SCS lead stylet with similar length was inserted into the lead (Figure 2B). If the length of the old SCS lead is unknown, the distal lead can be cut shorter before inserting the introducer sheath and the stylet. If the stylet is longer than the old lead, the tip of the stylet reaching the proximal end of the old lead will be felt. In this case, the patient requested the new SCS leads in the same previous lead position. Therefore, the stylet was inserted to occupy the entire length of the old lead to maintain the new lead at the same position. If the proximal end of the old lead is broken or separated, the stylet should not be passed into the damaged area to prevent further damage or separation of the broken lead. The introducer sheath was gently pushed and rotated over the old lead (Figure 2C). Some resistance was encountered when the introducer sheath passed through the scar tissue and proliferated ligamentum flavum. During insertion, the old SCS lead should be held firmly to prevent pulling the lead out of the previous position and epidural space. Comparing to the old technique that does not utilize a stylet, this technique allows for easier and faster insertion of the introducer sheath. Under the fluoroscopic guidance, the introducer sheath was passed into the epidural space until the

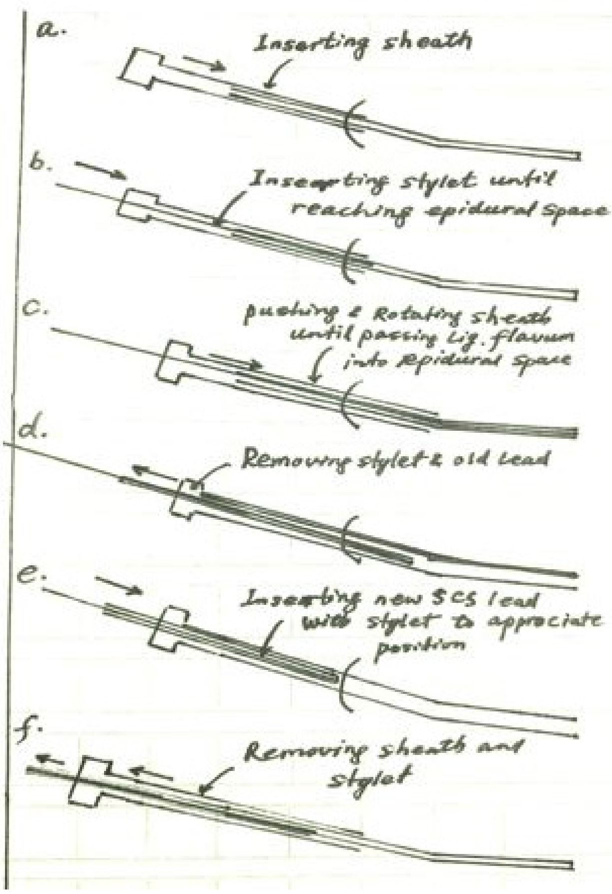

Figure 2: The detail of the old lead removal and new lead replacement.

tip of the sheath reached the lower electrode of the old SCS lead.

The old lead was removed while keeping the introducer sheath in position (Figure 2D). A new SCS lead (Medtronic octopolar lead) was inserted through the sheath until it reached the previous lead position (Figure 2E and 4). There was no resistance when inserting the new lead. A second new lead was inserted in the same technique. The introducer sheaths were removed (Figure 2F). It takes above ten minutes for lead replacement. The new leads were checked for impedance and programmed. The patient reported that the electrostimulation covered the same area as the former. The leads were then anchored to the deep fascia using standard technique. The patient was followed for 12 months after the revision procedure. She reported the paresthesia in the exact same area and NRPS at 1-2/10 with the new lead implantation without complication.

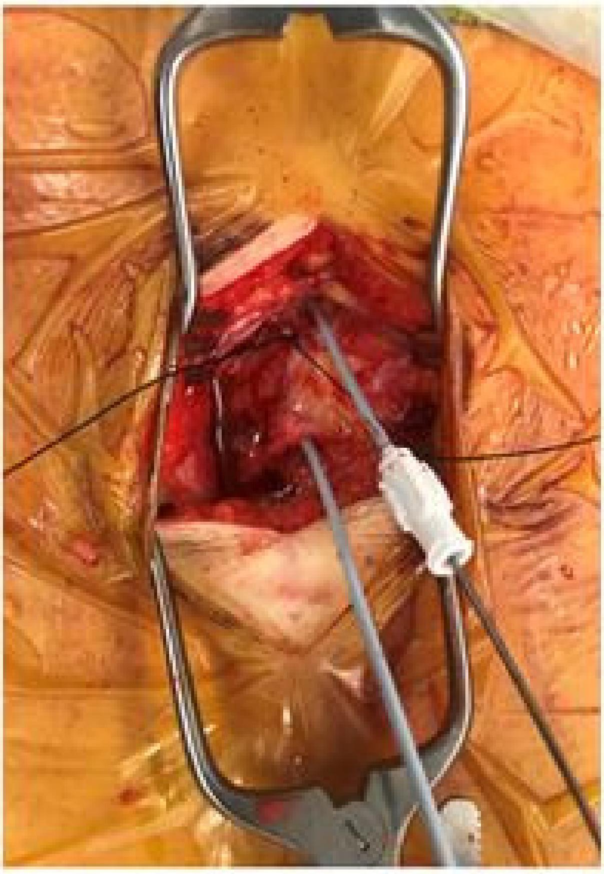

Figure 3: The introducer sheath passing the twisted lead.

Case Report 2

A 54-year-old female presented with a history of right and then left arm complex regional pain syndrome (CRPS, type I). She underwent twice of cervical SCS implantations. During her first surgery, two octopolar leads were inserted to the right and midline from C2 to C6 to cover her right arm symptoms. Two years later, she had a third SCS lead implantation to her left C2 to C6 to relieve her new left arm symptoms of CRPS, while the right and midline leads were not touched. The third lead was inserted into the same IPG to replace the midline lead. She received 70% of pain reduction from the SCS. Eight months after the procedure, she lost her therapy related complication of left arm paresthesia from the SCS. X-ray film and SCS programming showed the left lead migrating distally and malfunction.

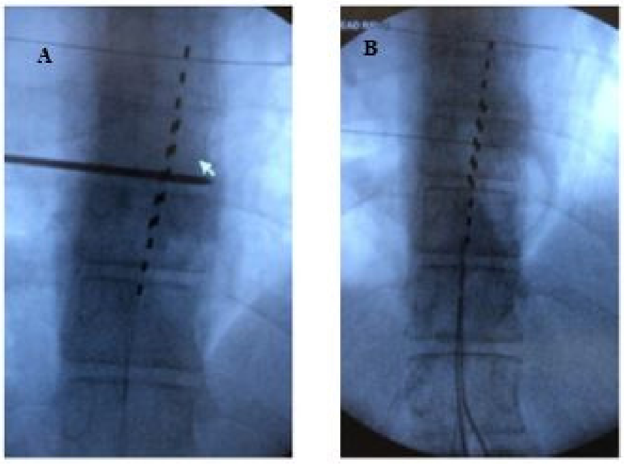

Figure 4: (A)- The leads before the revision and **(B)**- after the revision.

Procedural technique

The left lead was explored with the above technique while the proximal right and midline leads were not touched. Because the left lead had migrated distally, a new lead needed to be positioned. Therefore, the introducer sheath was inserted with care not to proceed too far after passing through the ligamentum flavum (in order to leave enough space for the new lead positioning). After freeing the old lead, an introducer sheath was inserted over the old lead. A stylet was inserted into the old lead until passing the ligamentum flavum. The introducer sheath was gently rotated and pushed until it passed the ligamentum flavum into the epidural space approximately 1/2 centimeter. After the old lead was removed, a new lead was inserted into the introducer sheath toward the desired direction under the fluoroscopic guidance. The introducer was removed. The standard technique was used to anchor and implant the lead and IPG. The patient was followed 4 months with excellent results and no complications.

Conclusion

Lead migration is a common complication in SCS therapy. So far, there has no similar report with this technique to replace percutaneous lead, although, De Coster had used a similar technique to move a paddle lead by removal of the broken lead with Epiducer sheath together. He replaced a new lead through the fibrinous sheath of the previous lead to the epidural space [6]. Loge also replaced a new lead through the fibrous sheath after removal of the old lead. They found that it was difficult to insert a new lead into the epidural space [7].

The above technique without using spinal needle can avoid needle induced epidural puncture and decrease trauma. It may decrease lead replacement time and position the replacement lead in the exact same anatomical location as the former.

This technique has been replicated in 2 additional patients with similar results. We hope this technique can help patients and healthcare providers who have faced this dilemma.

Conflict of Interest

The authors have not reported any conflicts of interest.

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