Original Article

Modified and systematically-designed installation procedure for spinal cord stimulation in the decubitus position under local anesthesia: a introductory technical case report

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Abstract: Introduction: Spinal cord stimulation (SCS) is sometimes preferable in some refractory chronic lower back pain (LBP) pathologies. SCS involves an insertion of electrode leads into the epidural space in the prone position under local anesthesia, followed by neurostimulator implantation under local/general anesthesia. These continuous procedures can cause transient post-operative LBP exacerbation and to make temporary pockets that will store redundant leads in it with some risk of subcutaneous irritation and infection in addition to making extra incisions. We introduce a modified simpler method for SCS implantation, systematically designed to be performed only under local anesthesia in a decubitus, non-prone position. Materials and methods: An 81-year-old patient with FBSS was treated. A physician was able to insert SCS leads with ease while the patient was in a decubitus position. The patient was comfortable, under totally local anesthesia, and the procedure produced no extra subcutaneous pockets. Result: The patient felt almost no LBP and reported no pain exacerbation during the operation. The SCS installation provided the patient with great improvement in both her lower back (NRS from 8 to 0-1) and leg (from 7 to 2) pain with a great improvement in her daily life activities. No adverse events were observed during the perioperative period. Conclusion: The modified SCS insertion method enabled us to achieve both intraoperative pain relief and complete SCS implantation in a minimally invasive manner.

Keywords: Spinal cord stimulation (SCS), failed back surgery syndrome (FBSS), lower back pain (LBP), less invasive, decubitus position

Introduction

The use of spinal cord stimulation (SCS) has been reported to be superior to traditional conservative medical management and revision surgery in multiple pain syndromes in some refractory chronic lower back pain (LBP) pathologies such as failed back surgery syndrome (FBSS), degenerative disc disease, and neuropathic pain including complex regional pain syndrome [1, 2]. The SCS procedure involves the placement of electrical leads into the midline epidural space. Once leads are in the correct position, pulses of electricity can be used to stimulate the dorsal surface of the spinal cord, which replace painful sensations with better tolerated sensations called paresthesia [3].

Percutaneous SCS is a popular method that consists of electrode leads and a subcutaneous pulse generator. This approach requires patients to lie in the prone position while leads are introduced into the epidural space four to six levels below the target treatment area under local anesthesia. Leads are then advanced to the desired location under fluoroscopic guidance. SCS leads are generally placed at the midline in the epidural space to stimulate the dorsal columns of the spinal cord and avoid stimulation of the dorsal root nerves that enter
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Figure 1. Radiological studies of the presented case. A, B. Plain lumbar radiograph. C. Magnetic resonance imaging. Radiological studies showed spondylosis with decreased disc height in and multiple bulging intervertebral discs with severe L3-4 foraminal stenosis.

Figure 2. Preoperative setting for lead placement. The patient was laid down in a decubitus position on her right side. A. The location of an anterior pocket, which was to contain the redundant leads during the neurostimulation trial period, was determined by placing a stimulator mock-up. The pocket was also used as a pocket for a neurostimulator. B. The length of the lead trajectory from the pocket was measured and confirmed via a scheduled incision on the back. The levels and location of the L3 pedicles and L3-4 interlaminar were marked up prior to fluoroscopic
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guidance, as the L1-2 interlaminae space was the site that had been predetermined for approach into the epidural space. A paper clip was applied at the level of T8 as a marker (*). C, D. The patient was draped in a usual sterile manner, and a wide opening was made in the drapery to expose the navel to the right iliac bone so that sufficient area was secured for the operation.

The spinal dorsal horn [4]. Once leads are located at an appropriate position and buried beneath the skin with enough extension lead outside of the body to connect to a temporary stimulator, trial stimulations are carried so that patients can validate successful pain relief. After the confirmation of effective stimulation, physicians implant a neurostimulator beneath a newly-made subcutaneous pocket in the lower abdomen, and this procedure is often done under general anesthesia in Japan (adopted from the manufacturer’s protocol (Medtronic, Minneapolis, MN). Once the leads are placed at an appropriate position, SCS can provide better analgesic effect, and improve health-related quality of life and functional capacity compared with conventional medical management [5].

While SCS is generally preferred over medical management and revision surgery, actual implantation of the technology has some drawbacks. First, the final positions of electrode leads are adjusted to specific points based on patient feedback, which means that a patient’s
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Intraoperative cooperation is important. Therefore, for the successful placement of leads, it is crucial that patients be kept comfortable during the operation. However, the standard surgical procedure used for this technology requires awake patients with LBP to lay in a prone position for a couple of hours, which often results in progressive LBP exacerbation. Additionally, elderly patients with LBP suffer from other pain such as neck pain and/or scapulohumeral periartitis, which the long-term prone position can exacerbate. A second drawback to SCS implantation is that the electrode lead can be as long as 75 cm, which is too long to temporarily bury beneath the skin. In these cases, physicians are required to construct a temporary subcutaneous pocket so that the leads can be coiled in the back. This conventional approach can sometimes prevent a physician from making allowances for the expanding tension of the coils, and can also result in pain for patients.

Furthermore, coiling the leads into a temporary pocket can sometimes result in wound failure and infection. A third drawback is that SCS implantation sometimes requires general anesthesia in some countries such as Japan, which limits the chance for physicians to perform this procedure in a small-scale clinic. The present technical report aimed to suggest a modified method for SCS implantation in order to overcome these problems. Here, we describe a systematically designed technique that was performed with local anesthesia in a non-prone position.

Materials and methods

The present report describes the performance of our modified SCS implantation technique on one FBSS case. We obtained written informed consent from the patient.
Case presentation

An 81-year-old woman presented to our clinic with recurrent back and left leg pain that were refractory to multiple conservative and extensive treatments including opioid prescription. The woman had undergone a lumbar discectomy in 2000 and a lumbar laminectomy in 2009. The patient’s leg pain was located on the lateral side of her thigh and had been relieved for a couple of days after L-3 spinal nerve infiltration with 1.5-mL 1% xylocaine, indicating mainly L3 spinal nerve-related pain with apparent radiological findings except postoperative site. Her physical examination revealed no neurological deficits except for pain and numbness in her thigh. The patient was able to walk a short distance about 20-30 meters with the aid of a walker, but even this was painful and impaired her quality of life (QOL) and ability of daily living (ADL), scoring 80% on the Oswestry Disability Index (ODI). A radiograph showed spondylosis with decreased disc height and multiple bulging intervertebral discs with severe L3-4 foraminal stenosis (Figure 1). The patient scored an 8 for lower back pain and a 7 for leg pain on the pain numerical rating scale (NRS). She was diagnosed as having failed back syndrome with spondylotic L3-4 foraminal stenosis, and the patient chose SCS treatment instead of prior to further revision surgery.

Preoperative preparation

The patient was laid down in a decubitus position on her right side, and the location of an anterior pocket to contain the redundant leads during the neurostimulation trial period was determined by placing a stimulator mock-up (Figure 2A). This location was also used as a
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Placement of the dual stimulation leads was performed in the decubitus position in the same way as the manufacturer’s protocol instructed for the prone position (Figure 3). A specially designed Tuohy needle was inserted using a paramedial approach via a midline incision. After the removal of the needle stylet, the epidural space was confirmed using a standard loss-of-resistance technique (Figure 3A). To reduce the risk of lead damage that could result in intermittent stimulation or loss of stimulation, a shallow needle-insertion angle (45º or less) was adopted. The leads were then inserted to the initial target placement site under fluoroscopic guide (Figure 3B). In the decubitus position, the leads were much more controllable compared with the prone position. After insertion of the leads, optimal positioning was determined during intraoperative test stimulation for appropriate sensory mapping (Figure 3C). The leads were then anchored to the fascia using an anchoring device (Figure 3D).

**Subcutaneous lead introduction**

After anchoring the leads to the fascia, they were introduced to the temporary hole at the
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flank. Sufficient local anesthesia was ensured along the length of the tunneling route (Figure 4A) to avoid any pain caused by insertion in the temporary hole. The proximal end of the extension lead was gently introduced through the passing straw to the temporary hole (Figure 4B), and another surgeon simultaneously made a second anterior pocket (contralateral to the first) using local anesthesia. Another tunnel was made from the temporary hole to the anterior pocket using the tunneling tool followed by introduction of the lead to the anterior pocket (Figure 4C). After connecting the implanted lead to an extension lead (white circle in Figure 4D, 4E), the trajectory from the anterior pocket to the temporary hole was retraced followed by the introduction of the extension lead (Figure 4D, 4E). Redundant leads were then coiled into the anterior pocket, and the incisions were closed. Finally, the extension lead was connected to an external trial neurostimulator.

Neurostimulation system installation after a 1-week trial

After a 1-week trial period, the patient was placed again in a decubitus position (Figure 5A) and draped in the usual manner. Local anesthesia was applied around the incision of the anterior pocket, and extension leads were pulled out from inside of the pocket (Figure 5B). The most proximal of the externalized extensions had already been cut and removed before the draping, while the remaining extensions were removed, followed by connection and placement of the neurostimulator system (Figure 5C). The incisions to the anterior pocket and temporary hole were closed. Figure 5D and 5E show the post-operative lumbar radiograph with well-positioned leads.

Results

The total operative time for lead placement was 1:15 (hh:mm) and 0:29 for neurostimulator insertion. During lead placement, the epidural insertion was done within the first 8 minutes with ease. From there, most of the operative time was spent adjusting the lead position by obtaining feedback from the patient while we stimulated her pain area. The patient felt almost no LBP, and it was not exacerbated during the operation. The SCS installation provided the patient with great improvement in both lower back pain (NRS from 8 to 0-1) and leg pain (from 7 to 2). She was able to walk by herself with tolerable pain in her leg, and her ODI score improved from 80 to 48% 3 months after the SCS installation. No adverse events were observed during the perioperative period.

Discussion

The present technical report demonstrated a less invasive and more comfortable way to install the SCS system on a patient with chronic LBP from FBSS. The procedure was achieved by preoperative design of the lead trajectory in which the anterior pocket, future storage for the neurostimulator, was used as temporary storage for redundant leads during the trial period. This technique also prevented the need for another pocket during neurostimulator implantation, which allowed for much shorter operative time than traditional procedures. All of the current technique was conducted under local anesthesia and with the patient in a more comfortable decubitus position.

The efficacy of SCS on patients with FBSS has been reported in previous studies [6-8]. As previously mentioned, the intraoperative posture of patients with FBSS and chronic LBP must be considered when installing the SCS system. This is because when the long-term prone position is enforced, it can harm the patient by exaggerating the lumbar curvature and providing respiratory difficulties due to the continuous pressure on the thoracic cage, displacement of the abdominal viscera against the diaphragm, reduction of its excursion, and even possible obstruction of the carina by continuous external pressure [9]. Furthermore, ischemic sores can develop under continuous pressure for over hours [9]. A pillow or bolster can be used to reduce these problems [10]; however, not all of the issues are resolved and a prolonged prone position itself can still exacerbate LBP. Approaching the epidural space in a decubitus position with flexion is a common technique that is used in other forms of pain treatment, such as the epidural catheter, thus it is a much more common approach for most pain physicians. Time spent in the operating room for SCS installation should be more used for trial stimulation and not for insertion of leads in assuring optimal results [10].

Another merit to the decubitus position is that the patient can produce enough lumbar flexion.
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to create greater interlaminar space. This allows the physician to use a relatively thick Tuohy needle to access the epidural space with ease when compared to accessing the space in a prone position (Figure 6). A decubitus-positioned patient can also lie in a resting position with extension, which cannot be achieved in the prone position technique. Considering that bending forward can increase the length of the lumbar spinal processes up to 4 cm [11], the present method provides much easier SCS installation on patients with chronic LBP who tend to be difficult because of deformity, pain during the prolonged prone position, or requirement for general anesthesia.

There have been some technical reports regarding SCS installation. For example in case larger plate electrodes are needed, the approach to the epidural space under local anesthesia, including a laminectomy using a retractor system, has been described [12]. However, no current report describes the complete treatment procedure, including systematic placement of normal leads under local anesthesia. In this report, the systematically-designed trajectory demonstrated the profitability of employing the anterior pocket as a redundant lead storage that requires no general anesthesia. This is in contrast to the traditional method that requires another arbitrary temporary pocket, made closer to the back incision, to store redundant leads. Another pocket can cause longer redundant leads that result in storage and coiling difficulties, which may produce pain and wound failure including infection. Using the technique described here, physicians can achieve SCS installation in one stage if necessary. Furthermore, the fact that the SCS system can be implanted without general anesthesia may contribute to reduced medical expenses. Considering that SCS itself has been reported to be cost effective over the lifetime of those with chronic pain pathologies compared with conservative treatments involving long-term opioid prescription [13-15], the present procedure suggests more economic efficiency.

In conclusion, we have developed a modified technique for systematic SCS installation that can be performed under local anesthesia. Furthermore, the present technique achieves intraoperative pain relief by using the decubitus position instead of the prone position.

Disclosure of conflict of interest

None.

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