

Spinal Cord Stimulation advanced level

Overview

Spinal cord stimulation uses low voltage stimulation of the spinal nerves to block the feeling of pain. Used since the 1970's, it may be an option if you have long-term (chronic) back pain, particularly leg pain, and have not found relief through traditional methods. A small generator, implanted in your back or abdomen, transmits an electrical current to your spinal cord. The result is a tingling sensation instead of pain. By interrupting the pain signal, the procedure has shown success in returning some people to an active lifestyle. This surgical procedure can help treat chronic pain caused by:

- **Failed back surgery syndrome:** failure of one or more surgeries to control persistent leg pain (sciatica), but not technical failure of the original procedure.
- **Reflex sympathetic dystrophy:** a progressive disease of the nervous system in which patients feel constant chronic burning pain.
- **Causalgia:** a burning pain caused by peripheral nerve injury.
- **Arachnoiditis:** painful inflammation and scarring of the meninges (protective layers) of the spinal nerves.

What is spinal cord stimulation?

Spinal cord stimulation (also known as dorsal column stimulation) uses a device that is surgically placed under your skin to send mild electric shocks to your spinal cord. A small wire called a [lead](#) carries the shocks from a generator/battery implanted in your abdomen to the nerve fibers of the spinal cord causing pain (Fig. 1). When turned on, the stimulation feels like a mild tingling. Your pain is reduced because the mild electrical shocks interrupt the pain signal to your brain.

Stimulation does not eliminate the source of pain, it simply interferes with the signal, and so the amount of pain relief varies for each person. Also, some patients find the tingling sensation unpleasant. For these reasons a trial stimulation is performed before the device is permanently implanted. The goal for spinal cord stimulation is a 50-70% reduction in pain. Stimulation does not work for everyone; the implant is removable and does not damage the spinal cord or nerves.

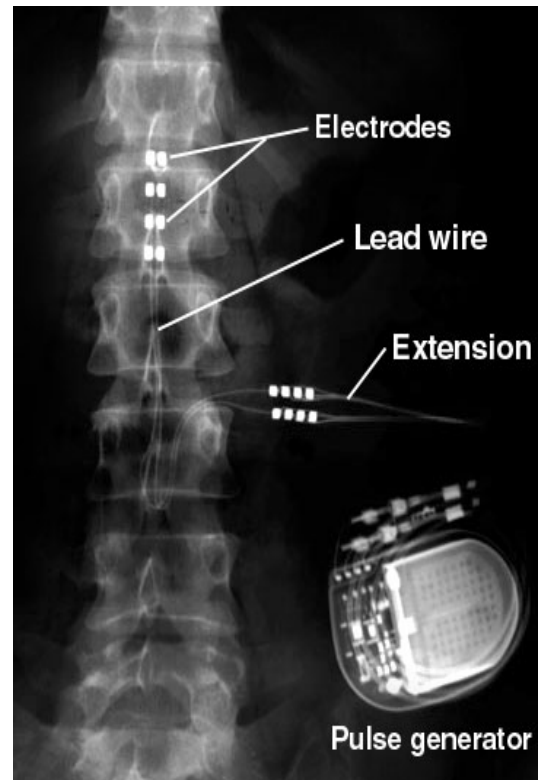


Figure 1. The spinal cord stimulation system consists of a pulse generator implanted under the skin of your abdomen and a lead that carries electric current from the generator to electrodes placed over the spinal nerves.

The stimulation system

There are two types of stimulation systems: an internal pulse generator/battery or an external radiofrequency/transmitter. Both systems consists of:

- A lead wire with a number of electrodes (4-16) that is implanted above the spinal cord to deliver electrical pulses
- An extension that carries the electrical pulses from the power supply to the lead
- A power supply that generates the electrical pulses

The internal battery system, which delivers low voltage, needs to be surgically replaced every 2 to

5 years depending on usage. If higher voltage or multi-lead therapy is needed for pain relief, an external radio-frequency (RF) system may be chosen. In an RF system, the pulse generator is implanted and the power source is worn on a belt with an antenna over the receiver. The doctor will be able to select the best type of system for you during the trial stimulation.

The transmitter stimulator has three parameters: frequency, pulse width, and pulse amplitude. Each of these can be repeatedly adjusted for best results.

Once the amplitude, electrode pulse width and frequency for your symptoms have been determined, you are sent home with instructions for regulating the stimulation program by controlling only the amplitude, and the length of each stimulation period.

Usually one or two hours of stimulation, three to four times a day are enough to relieve pain for the remainder of the day. Your doctor may alter the pulse width, amplitude and frequencies on follow-up visits if necessary.

Am I a candidate?

Before determining if spinal cord stimulation is an option, your condition will be thoroughly evaluated and assessed. A psychologist may assess your mental condition and a neurosurgeon or physiatrist will evaluate your current medication regime and physical condition. The doctor will want to review all previous treatments including medication, physical therapy, injections, and surgeries.

Patients selected for this procedure usually have had a disability for more than 12 months and have pain in their lower back and leg (sciatica). The typical candidate has had one or more failed spinal surgeries.

According to a 1996 article published by Elliot Krames M.D. in the Journal of Pain and Symptom Management, there are seven criteria that you must meet before you have the operation.

- Conservative therapies have failed
- The source of your pain has been verified by your doctor
- You would not benefit from additional surgery
- You are not seriously dependent on pain medication or other drugs
- You do not have psychological problems
- There are no medical conditions that would keep you from undergoing implantation
- A trial stimulation was successful

If your pain is caused by a correctable condition, then this must be fixed first. Also, if you have a cardiac pacemaker, you cannot have a stimulator.

Who performs the procedure?

Neurosurgeons and doctors who specialize in surgical intervention for pain and spine disorders implant devices for spinal cord stimulation.

The procedure is performed on an out patient basis in two stages: Stage 1 is a trial stimulation and Stage 2 is implantation of the permanent device.

Stage 1. Trial stimulation

Trial stimulation is very important to determine if the procedure will be successful. It will tell if stimulation is correct for the type, location, and severity of your pain. It will also evaluate the effectiveness of various stimulation settings of the device.

The insertion of trial leads is performed under light sedation (see Step 2 below). The lead is then attached to an external generator/power supply (worn on a belt) and stimulation settings are programmed.

After the trial procedure, you will be sent home with instructions on how to use the trial stimulator and care for your incision site. Keep a written log of the stimulation settings during different activities and the level of pain relief. After 3-5 days, you will return to the doctor's office to discuss permanently implanting the generator/receiver or removing the trial leads.

Stage 2. Permanent implantation

During the trial stimulation, your doctor gathered information about the number of electrodes needed and the type of stimulation that works best for you. You will either have an internal pulse generator system or an external radio-frequency (RF) system.

What happens before surgery?

You may be scheduled for presurgical tests (e.g., blood test, electrocardiogram, chest X-ray) several days before surgery. In the doctors office you will fill out paperwork and sign consent forms. Patients are admitted to the hospital the morning of the procedure. No food or drink is permitted past midnight the night before surgery. An IV line is started in your arm. An anesthesiologist will explain the effects of anesthesia and its risks.

What happens during surgery?

There are two parts to the procedure: placement of the lead in the epidural space of the spinal cord and placement of the generator/battery in the abdomen. There are five main steps of the procedure, which generally takes 3–4 hours.

Step 1. Prepare the patient

You are placed lying on your side on the operative table and given light sedation. Next, the areas of

your back and stomach are shaved and prepped where the leads and the generator or receiver are to be placed.

Step 2. Placement of the leads

Placement of the leads is performed with the aid of fluoroscopy (a type of X-ray) either percutaneously (through the skin) or by direct skin incision. ⁽⁵⁾ Percutaneous insertion uses a hollow needle to pass the lead into the area above the spinal cord. A small skin incision is made in the middle of your back. The bony arch (lamina) of the vertebra is exposed. A portion of the lamina is removed (laminotomy) to allow room to place the leads. The leads are placed in the epidural space above the spinal cord and secured in place with sutures (Fig. 2). You will be awakened so that you can help the doctor determine how well the stimulation covers your pain pattern without feeling any pain or discomfort from the lead implantation itself. Your surgeon will decide how many leads and the number of electrodes on the lead to implant.

In many cases, if the leads implanted during the trial are positioned perfectly, there is no need to reposition or insert new leads.

Step 3. Tunneling of the extension

Once the leads are in place, an extension wire is passed under the skin from the spine, around your torso to the abdomen where the generator will be implanted.

Step 4. Placement of the generator

A 4-6 inch skin incision is made in the side of your abdomen below the waistline. The surgeon creates a pocket for the pump between the skin and muscle layers. The extension catheter is attached to the pulse generator (or receiver). Next, the pump is correctly positioned under the skin and sutured to the thick fascial layer overlying the stomach muscles.

Step 5. Test stimulate

You will be awakened so that the permanent generator and the placement of the leads can be tested. You must be able to tell the surgeon if the tingling sensation is the same as during the trial stimulation.

Step 6. Close the incisions

The incisions in your back and abdomen are closed with sutures or staples and a dressing is applied.

What happens after surgery?

You will wake up in the recovery area. Your blood pressure, heart rate, and respiration will be monitored, and your pain will be addressed. Most patients are usually discharged home the same day. Approximately 10 days after the procedure you will come to the office to remove the sutures or staples.

The stimulator will be programmed. It is important to work with your doctor to adjust your medications and refine the programming of the stimulator.

Discharge instructions

Discomfort

1. After surgery, pain is managed with narcotic medications. Because narcotic pain pills are addictive, they are used for a limited period (2 to 4 weeks). Their regular use may cause constipation, so drink lots of water and eat high fiber foods. Laxatives (e.g., Dulcolax, Senokot, Milk of Magnesia) may be bought without a prescription. Thereafter, pain is managed with acetaminophen (e.g., Tylenol) and non-steroidal anti-inflammatory drugs (NSAIDs) (e.g., aspirin; ibuprofen, Advil, Motrin, Nuprin; naproxen sodium, Aleve).
2. Spinal headaches are caused by leakage or loss of CSF around the catheter or lead site. Lie flat and drink plenty of caffeinated non-carbonated fluids (tea, coffee).

Restrictions

3. Avoid these activities for 6 to 8 weeks to prevent movement of the catheter/leads:
 - do not bend, twist, stretch, or lift objects over 5 pounds
 - do not raise arms above your head
 - do not sleep on your stomach
 - do not climb too many stairs or sit for long periods of time
4. Do not drive for 2 to 4 weeks after surgery or until discussed with your surgeon.
5. Housework and yard-work are not permitted until the first follow-up office visit. This includes gardening, mowing, vacuuming, ironing, and loading/unloading the dishwasher, washer, or dryer.
6. Postpone sexual activity until your follow-up appointment unless your surgeon specifies otherwise.

Activity

7. Gradually return to your normal activities. Walking is encouraged; start with a short distance during the 1st two weeks and then gradually increase to 1 to 2 miles daily. A physical therapy program may be recommended.

Bathing/Incision Care

8. You may shower as directed by your surgeon. Do not take a tub bath or submerge yourself in water for 4 weeks. Pat your incision dry with a soft towel to avoid irritation.
9. Inspect the incision line twice daily.
10. Fluid may accumulate under the skin around the catheter/leads or the device creating a visible swelling. Call the doctor if this occurs.

Seromas usually disappear by themselves but may require a drain.

11. Steri-strips may cover the incision. After showering, gently pat dry the steri-strips. Gently remove steri-strips after one week. Sutures or staples that remain in place when you go home will need to be removed. Ask your surgeon or call the office to find out when.

When to Call Your Doctor

12. If your temperature exceeds 101° F or if the incision begins to separate or show signs of infection, such as redness, swelling, pain, or drainage.
13. If your headache persists after 48 hours.
14. If you have sudden severe back pain, sudden onset of leg weakness and spasm, loss of bladder and/or bowel function - **this is an emergency** - go to a hospital and call your surgeon.
15. Make an appointment for 2 weeks after surgery unless otherwise instructed. Call the appointment desk at 513-569-5222.

What are the results?

The results of spinal cord stimulation depend on strict patient selection, proper surgical technique, intra- and postoperative testing, and patient education. Stimulation does not cure the condition causing pain; it helps patients to tolerate pain.

Recent results of spinal cord stimulation show good to excellent long-term relief in 60 to 70% of patients suffering from chronic pain. ⁽¹⁻³⁾ One study reports that 48% of patients improved sufficiently to return to gainful employment or housework with stimulation alone or supplemented by occasional oral pain medication. ⁽¹⁾

What are the risks?

Research has shown that the stimulator does not damage the spinal cord or spinal nerves. However as with any surgery, there are risks involved including infection or complications of anesthesia. Depending on how often the stimulator is used, the battery will eventually need to be replaced every 2 to 5 years. The nine-volt batteries in the RF receiver should be replaced frequently.

Conditions for which you might need additional surgery include movement of the lead or failure of the device, although these possibilities are rare. Reasons for removal of the device include infection, failure to relieve pain, and patient misuse.

Living with a stimulator

You control the time and duration of the stimulator with a handheld controller. Most patients turn the stimulator on during the day and off at night. Some patients turn it on at night in order to sleep. Everyone's pain is different. Do not use the stimulator while driving.

Just like a cardiac pacemaker, other devices such as cellular phones, pagers, microwaves, security doors, and anti theft sensors will not affect your stimulator. Be sure to carry your Implanted Device Identification card when flying, since the device is detected at airport security gates.

To avoid damage or adverse effects to your spinal cord stimulator, avoid the following medical procedures: MRI, ultrasound, defibrillator, electrocautery, diathermy, and cardiac pacemakers. Also, chiropractic manipulation may cause the lead to move - consult your surgeon first.

Sources & Links

If you have more questions, please contact the Mayfield Spine Institute at 800-325-7787 or 513-221-1100. Additional information is available on the web.

www.spinehealth.com
www.medtronic.com
www.painintervention.com

References

1. Kumar K, Wyant GM, Ekong CEU: Epidural spinal cord stimulation for relief of chronic pain. *The Pain Clinic* 1:91-99, 1986.
2. Sbatin D, Mullett K, Hults G: Totally implantable spinal cord stimulation for chronic pain: Design and efficacy. *Pace* 9:577-583, 1986.
3. Racz GB, McCarron RF, Talboys P: Percutaneous dorsal column stimulator for chronic pain control. *Spine* 14:1-4, 1989.
4. Krames, E., *Intraspinal Opioid Therapy for Chronic Nonmalignant Pain: Current Practice and Clinical Guidelines*, *JPSM* (6): 333-352, 1996.
5. Villavicencio AT, Leveque JC, Rubin L, Bulsara K, Gorecki JP. Laminectomy versus percutaneous electrode placement for spinal cord stimulation. *Neurosurgery* 46:399-406, 2000.

Glossary

laminotomy: surgical cutting of the laminae or vertebral arch of the vertebra.

lead: a small medical wire that has electrodes at one end. Electrical current passes from a battery, along the wire, to the electrodes. Two types; percutaneous and surgical leads.

fluoroscopy: an imaging device that uses x-ray or other radiation to view structures in the body in real time, or "live". Also called a C-arm.

percutaneous: by way of the skin. (e.g., injection).

peripheral nerve stimulation: a surgical treatment for pain in which specific nerves are stimulated rather than the general area of the spinal cord.

sciatic nerve: nerve located in the back of the leg which supplies the muscles of the back of the knee and lower leg and sensation to the back of the thigh, part of the lower leg, and the sole of the foot.

sciatica: pain that courses along the sciatic nerve in the buttocks and down the legs. Usually caused by compression of the 5th lumbar spinal nerve.

seroma: a mass formed by the collection of tissue fluids following a wound or surgery.

spinal hygroma: an accumulation of cerebrospinal fluid under the skin, which produces a visible swelling, caused by leakage around a catheter, drain, or shunt.

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