

Spinal Cord Stimulation or SCS is a technique involving electrical stimulation of a precise part of the spinal cord. A very low energy current is used.

This essentially shuts down the pain signals from the part of the body served by that area in the spinal cord. Whilst providing pain relief, other sensory input is not affected and there is normal motor (muscular) function.

Basically, the theory behind SCS is that sending non-painful signals will block out the painful ones: in much the same way as we instinctively rub our hand if we have banged it.

Instead of feeling pain, the patient will experience tingling.

Two carefully positioned leads (insulated) with electrodes on the end are placed adjacent to the spinal cord: one end rests in the epidural space whilst the other is attached to a battery operated (9v) signal generator.

The Implantable pulse generator (IPG) is titanium-encased and it supplies the energy for stimulation. It contains a special battery and electronic circuitry. It is approximately 60 mm (2.5 inches) at the longest point and 52 mm (2.25 inches) at its widest point. It is about 10 mm (0.4 inches) thick.

The receiver is surgically implanted, usually in the patient's abdominal area. It contains electronic circuits but no battery. The receiver receives electrical pulses from the transmitter and sends them via the leads to the electrodes next to the spinal cord or, in some cases to a peripheral nerve.

The external transmitter may be worn on a belt. It sends radiofrequency signals to the electrodes; amplitude, pulse width, and rate of the electric pulse can be varied non-invasively. There is also an antenna that is positioned over the implanted receiver.

Patients who are considered suitable for SCS first undergo a trial in which a lead is implanted in the epidural space and stimulation applied. If the patient finds that this is helpful then the full system will be implanted.

RESULTS WITH SCS:

Kumar et al ([\[1\]](#)) looked at 121 patients using SCS for a variety of painful condition.

They concluded that epidural SCS is safe and effective on the basis that 40% of the patients were able to control their pain with neurostimulation alone whilst a further 12% required the use of analgesics to achieve more than 50% pain relief.

“Pain secondary to arachnoiditis or perineural fibrosis following multiple intervertebral disc operations, when predominantly confined to one lower extremity seemed to respond favorably to this treatment.”

They noted that pain due to cauda equina injury, paraplegic pain, phantom-limb pain, pure midline back pain without radiculopathy, or pain due to primary bone or joint disease was less responsive to SCS.

However, the Pain Management Center of the University of Utah Hospitals and Clinics website ([\[2\]](#)) reports much less encouraging figures:

“Outcome:

55% report initial relief
Relief after 6 months 33%
Relief after 2 years 12%
Relief after 10 years 5%"

The progressively lower success rate over time is attributed to fibrosis around the electrode tip, pain spreading to areas not covered by the electrode and breakdown of the system.

Long ([\[3\]](#)) cited an immediate success rate of <70%, intermediate <50% and long term <30%. He favoured this form of therapy as standard when pain is a major problem.

Midha and Schmitt ([\[4\]](#)) have looked at the use of SCS in spinal cord injury patients to treat pain and spasticity (increased muscle tone, muscle spasms). They have stated that

"The epidural spinal cord stimulator lacks long-term efficacy for the relief of spasticity and pain and is not cost effective."

Kay et al. from Dundee, ([\[5\]](#)) looked at SCS as an established treatment for chronic pain, angina and peripheral vascular disease over a 13 year period.

The retrospective study of 70 patients who had severe pain refractory to other treatment, showed that there were 72 surgical revisions (electrode repositioning/replacement, generator replacement, cable failure) of which 12 were implant removals. Half of the devices were revised within 3 years. 6 implants became infected.

60% of the patients reported substantial pain relief.

Midha et al. ([\[6\]](#)) investigated SCS as treatment of spasticity and spasms following spinal cord injury (these are common problems in arachnoiditis). 7 out of 17 patients required a second implantation and in only 1 was there any symptomatic relief.

The authors therefore concluded:

“The epidural spinal cord stimulator lacks long-term efficacy for the relief of spasticity and pain and is not cost effective”.

Devulder et al. ([\[7\]](#)) in Belgium, looked at SCS use in Failed back surgery syndrome. 26 of 69 patients stopped using this treatment, of which in 10 there was no clear reason. 43 obtained “good pain relief”. Some still required opioid analgesics in addition to the SCS.

Hieu et al. ([\[8\]](#)) found that in FBSS patients, “Long-term efficacy was good in 63.6% of cases, fair in 22%, and poor in 6.5%; treatment failure occurred in 7.9% of cases.

Adverse events included one case of meningitis, two cases of local infection, and one case each of cerebrospinal fluid fistula and necrosis of the skin overlying the stimulator. The main causes of treatment failure were complications, inappropriate patient selection, and the escape phenomenon.”

Van de Kelft and De La Porte ([\[9\]](#)) treated patients with pain in one or both legs. 54% continued to experience at least 50% pain relief during a mean follow-up period of 47 months. 91% were able to reduce their medication intake and 60% reported an improved lifestyle.

LeDoux and Langford ([\[10\]](#)) reported that 76% of patients with FBSS at 1 year and 74% at 2 years were still experiencing 50% or better pain relief. Electrode migration was the most common complication.

De La Porte and Van de Kelft's earlier study showed ([\[11\]](#)) 55% continued to experience at least 50% of pain relief for a mean follow-up of 4 years. 90% were able to reduce their medication, 61% reported improved lifestyle.

North et al. ([\[12\]](#)) found a success rate (at least 50% sustained pain relief and patient satisfaction) in 53% of patients at 2.2 years and in 47% of patients at 5.0 years postoperatively.

Manufacturers Medtronic state

"Typically, people who find the therapy helpful experience 50%-70% pain relief." ([\[13\]](#))

Meilman et al ([\[14\]](#)) also state that SCS is of greater efficacy for unilateral lower limb pain than for more widespread nerve root involvement. It is best for controlling the dull, constant pain and poor for the sharp, lancinating pain. SCS may also be useful for neurogenic bladder problems. ([\[15\]](#))

In Chapter XXIII, Aldrete and Ghaly describe electrical stimulation techniques, such as spinal cord stimulation (SCS).

The authors conclude

"Still rather unpredictable as far as long-term results is concerned; SCS has potential to provide pain reduction, but not real pain relief."

Patients with one limb affected have the best chance of success. Brain stimulation "may be more promising when technological advances will make it non-invasive."

ADVERSE EFFECTS OF SCS include:

Infection, bleeding, haemorrhage, haematoma, headache, hardware difficulties, spinal cord injury, allergic reactions, paralysis, pain at implant site. Kumar et al. noted in particular: Complications included wound infection, electrode displacement or fracturing, and fibrosis at the stimulating tip of the electrode.

General complications with the system include: no stimulation or intermittent stimulation, stimulation in the wrong location, loss of pain relieving effect and allergic response to system.

IMPORTANT NOTE:

Anti-theft and metal detector systems may affect spinal cord stimulators, due to the effect of their electromagnetic fields. These security systems may cause over stimulation, and patients will report pain, jolts and shocks.

[1] Kumar K, Nath R, Wyant GM *J Neurosurg* 1991 Sep; 75(3):402-407 Treatment of chronic pain by epidural spinal cord stimulation: a 10 year experience.

[2] Internet resource: Pain Management Center University of Utah Hospitals and Clinics http://www-medlib.med.utah.edu/pain_center/education/outlines/sc_stim.html

[3] Long D.M. *Neurosurgery Quarterly* 1992. 2(4): 296-319 Chronic Adhesive Spinal Arachnoiditis: Pathogenesis, Prognosis, and Treatment. *Neurosurgery Quarterly* 1992. 2(4): 296-319

[4] Midha M, Schmitt JK *Spinal Cord* 1998 Mar; 36(3):190-2 Epidural spinal cord stimulation for the control of spasticity in spinal cord injury patients lacks long-term efficacy and is not cost-effective.

[5] Kay AD, McIntyre MD, Macrae WA, Varma TR. *Br J Neurosurg* 2001 Aug;15(4):335-41 Spinal cord stimulation--a long-term evaluation in patients with chronic pain.

[6] Midha M, Schmitt JK. *Spinal Cord* 1998 Mar; 36(3):190-2 Epidural spinal cord stimulation for the control of spasticity in spinal cord injury patients lacks long-term efficacy and is not cost-effective.

[7] Devulder J, De Laat M, Van Bastelaere M, Rolly G. *J Pain Symptom Manage* 1997 May;13(5):296-301

Spinal cord stimulation: a valuable treatment for chronic failed back surgery patients.

[8] Hieu PD, Person H, Houidi K, Rodriguez V, Vallee B, Besson G. *Rev Rhum Ed Fr* 1994 Apr;61(4):271-7

Treatment of chronic lumbago and radicular pain by spinal cord stimulation. Long-term results

[9] Van de Kelft E, De La Porte C. *Qual Life Res* 1994 Feb;3(1):21-7 Long-term pain relief during spinal cord stimulation. The effect of patient selection.

[10] LeDoux MS, Langford KH. *Spine* 1993 Feb;18(2):191-4 Spinal cord stimulation for the failed back syndrome.

[11] De La Porte C, Van de Kelft E. *Pain* 1993 Jan;52(1):55-61 Spinal cord stimulation in failed back surgery syndrome.

[12] North RB, Ewend MG, Lawton MT, Kidd DH, Piantadosi S. *Neurosurgery* 1991 May;28(5):692-9

Failed back surgery syndrome: 5-year follow-up after spinal cord stimulator implantation. [13]

Internet resource: Medtronic site:

<http://www.dantec.dk/neuro/apt/faq4.html#5>

[14]

Meilman PW, Leibrock LG, Leong FT

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1989 Jun; 5(2): 189-93 Outcome of implanted spinal cord stimulation in the treatment of chronic pain: arachnoiditis versus single nerve root injury and mononeuropathy. Brief clinical note.

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Ronzoni G, De Vecchis M, Rizzotto A, Raschi R, Cuneo L

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(Paris) 1988; 22(1): 31-4 [Long-term results of spinal cord electrostimulation in the treatment of micturition disorders associated with neurogenic bladder].