SCS has been used for more than 20 years. However, the use of electricity to treat pain dates back to as early as 600 BC when electric eels were applied to painful areas. In the 1920s, electricity was suggested for treating conditions as varied as cancer and drug addiction.

In the late 1960s the dorsal column stimulator was introduced. This was an early prototype of SCS. However, it had a poor success rate : long-term success in the 1960s and 70s was seen in approximately 40% of the patients.

Nowadays, there is some improvement in the technology and thus the results, but overall the long-term success rate is not much more than 50% with unipolar devices, although with multipolar devices (which have more than one set of electrodes) may do better.

SCS may be used to treat patients with Failed Back Surgery Syndrome, arachnoiditis, neuropathic limb pain, phantom limb pain, Reflex Sympathetic Dystrophy (RSD or CRPS: Complex Regional Pain Syndrome) It may also be used in intractable angina and peripheral vascular disease.

SCS may also be of use in neurogenic bladder problems (but this use is not within the remit of this article.)

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 ([i]) 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. They found that pain confined predominantly to one limb responded best.

However, the Pain Management Centre of the University of Utah Hospitals and Clinics website ([ii]
)reports much less encouraging figures:

"Outcome:

1. 55% report initial relief
2. Relief after 6 months 33%
3. Relief after 2 years 12%
4. 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.

Midha and Schmitt([iii]) 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."

Hieu et al ([iv]) evaluated the efficacy of SCS in long-term treatment of low back pain and found that "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 and two cases of local infection.

SUCCESS?..... manufacturers Medtronic state "Typically, people who find the therapy helpful experience 50%-70% pain relief." ([v])

ADVERSE EFFECTS OF SCS:
These include:

- infection
- bleeding, hemorrhage
- headache
- hardware difficulties
- spinal cord injury
- allergic reactions
- failure to relieve pain
- paralysis
- haematoma
- pain at implant site

General complications with the system

- no stimulation or intermittent stimulation
- stimulation in the wrong location
- loss of pain relieving effect
- 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 overstimulation, and patients will report pain, jolts and shocks.

Dr Sarah Andreae-Jones
Patron of ASG

[i] Kumar K, Nath R, Wyant GM *J Neurosurg*

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

[iii] 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.

[iv] 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].

[v] Internet resource: Medtronics site: http://www.dantec.dk/neuro/apt/faq4.html#5