DIRECT NERVE STIMULATION FOR PAINFUL PERIPHERAL NEUROPATHIES

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Nineteen patients with chronic pain due to a traumatic peripheral neuropathy were treated by means of implanted nerve stimulation. In 11 (58%) pain was completely relieved and in four (21%) it was reduced sufficiently to discontinue analgesics. The average follow-up was 11.5 months.

The technique is described and the failures discussed. The necessity for implanting the stimulator proximally is emphasised.

Although peripheral nerve stimulation has been used since 1965, only a few follow-up studies have been published. The range of painful conditions for which it has been used is so wide and varied that its effectiveness cannot be accurately assessed from these reports.

In this paper we describe the short-term results in a group of 19 patients suffering from intractable pain due to a peripheral neuropathy.

MATERIAL AND METHODS

A total of 77 patients with post-traumatic painful neuropathies were referred to us, out of whom 19 were selected as suitable for nerve stimulation. There were 10 women and 9 men with a mean age of 49 years, ranging from 38 to 73 years. Eleven patients had nerve lesions of the lower limbs (Table I).

There were four aetiological factors involved (Table II), the commonest being a lesion following an operation in the region of the hip or knee. The character of the pain varied, dragging, drilling and cutting pain being the most common; only two patients had burning pain, one femoral and one sciatic.

Before the patients were referred to us, they had already received standard conservative treatment and all but two had undergone neurolysis once, twice, or even three times.

Selection of patients. There were three criteria for selection.

Electrophysiological studies. Either the electromyogram (for motor or mixed nerves) or the somatosensory evoked potentials (for sensory nerves) had to show definite abnormalities.

Table I. Nerves involved

Sciatic	4
Femoral	3
Median	3
Posterior tibial	2
Peroneal	2
Ulnar	2
Lateral cutaneous nerve of the thigh	1
Greater occipital	1
Intercostal	1

Table II. Aetiology

Operative trauma		10
Total hip replacement	2	
Herniotomy	2	
Total knee replacement	1	
Knee arthrodesis	1	
High tibial osteotomy	3	
Thoracotomy	1	
Burn graft removal	1	
Nerve tumour resection	1	
Entrapment neuropathies		6
Injection injuries		2
Nerve graft		1

Selective nerve blocks. When the nerve, localised by means of percutaneous electrical stimulation (1 Hz; 0.2 to 0.3 volt), was blocked proximal to the injured area with 1 ml of 0.5% bupivacaine, this had to give complete freedom from pain for at least the duration of the anaesthesia. This nerve injection was repeated twice.

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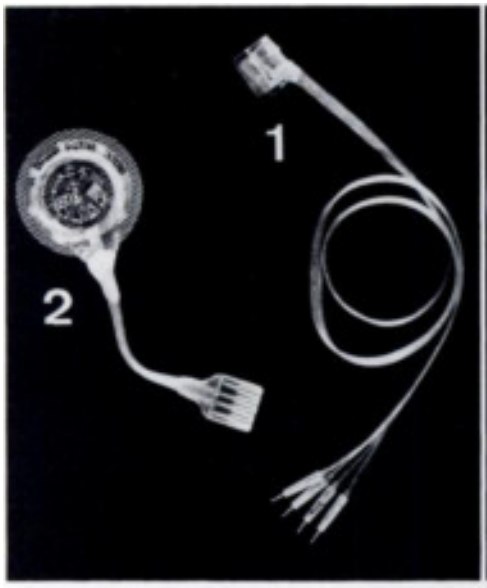

Fig. 1

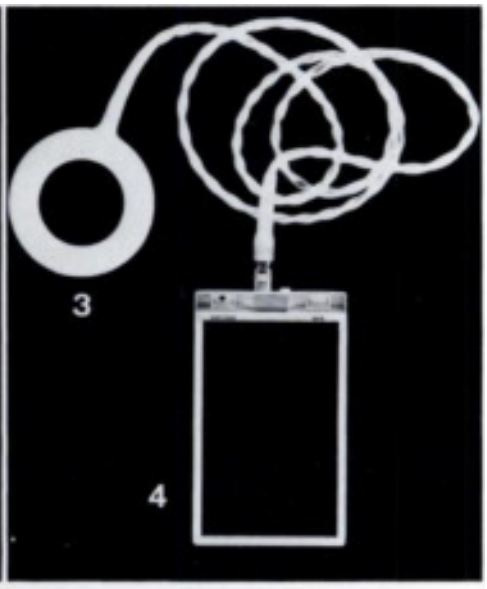

Fig. 2

The Avery peripheral nerve stimulator: 1, electrodes; 2, receiver; 3, antenna; and 4, transmitter.

Percutaneous electrical stimulation. If the nerve block relieved the pain completely, a needle was inserted proximal to the lesion and stimuli applied sufficient to produce paraesthesiae in the painful area (80 to 100 Hz and 0.3 volt, for 30 minutes); for the patient to be included in the series, this pain had to be relieved by at least 50%.

Patients with major psychopathological disorders were excluded from the series.

Surgical technique. The Avery peripheral nerve stimulator with a cuff of four platinum electrodes is used (Figs 1 and 2). The operation is performed in two sessions: the first is under general anaesthesia, spinal anaesthesia, or a plexus block, varying with the nerve involved. The nerve is exposed for at least 10 cm proximal to the injury. No neurolysis of the involved area is performed. The electrode cuff is sutured to the perineurium with an absorbable 5 0 suture. The cable from the cuff is then buried subcutaneously, some 5 cm proximally.

Two days later, under local anaesthesia, the electrode plugs are pulled out and connected to the electrode position selector switch. This is adjusted until the paraesthesiae are felt exactly in the painful area; the receiver is then implanted in this position.

Technique of stimulation. An external transmitter connected to an antenna is then taped to the area where the receiver has been implanted. The pulse width, rate and voltage that obtain the best response are then selected. On the first day the stimulator is used intermittently one hour on, one hour off, and the patient fills in an hourly chart indicating the percentage pain relief during stimulation and between stimulations.

Complications. In two patients skin broke down at the site of implantation of the receiver, and one developed necrosis over the cables: after plastic surgery, healing was achieved. There was one infection, in a patient with a median nerve graft; the implant had to be removed.

RESULTS

Only short-term results are available as the follow-up only ranged from 4 to 29 months, with a mean of 11.5 months. They were evaluated as follows.

Very good: complete pain relief with stimulation.

Good: more than 50% relief of pain (subjective estimate) with abstinence from analgesics.

Poor: less than 50% improvement.

Of the 19 patients, 11 were classified as very good, four as good and four poor. Neither the cause of the pain (Table III) nor the nerve involved influenced the result.

Table III. Results according to aetiology

	Very good	Good	Poor
Operative trauma	6	2	2
Entrapment neuropathies	4	2	0
Injection injuries	1	0	1
Nerve graft	0	0	1
Total	11	4	4

Of the four patients rated as having poor results, one had what was diagnosed retrospectively as a centrally fixed pain; another became infected; and an elderly lady with a sciatic lesion was relieved of pain for six months, but she had endogenous depression and her pain recurred when her psychiatric condition became worse. The fourth patient with a poor result had a peroneal nerve lesion following arthrodesis of the knee; in her, the electrode cuff was implanted very close to the lesion. Pre-

operatively a peroneal nerve block had given only partial relief from pain, but with a sciatic nerve block she had been painfree. She is scheduled to have a new electrode implanted on the sciatic nerve, proximally in the thigh.

Table IV. Results according to nerve involved

	Very good	Good	Poor
Sciatic	3	0	1
Femoral	1	1	1
Median	3	0	1
Posterior tibial	0	2	0
Peroneal	0	1	1
Ulnar	2	0	0
Lateral cutaneous nerve of the thigh	1	0	0
Great occipital	1	0	0
Intercostal	1	0	0
Total	11	4	4

Of the four partial successes three involved nerves below the knee, in two the posterior tibial nerve, and in one the peroneal nerve (Table IV). Although implanted proximal to the lesions, the electrode cuff should probably have been implanted still more proximally, on the sciatic nerve. In one patient it was implanted on the femoral nerve, giving relief from the leg pain, but the burning pain in the thigh remained unchanged; this pain was eventually improved by blocking the sympathetic chain in the abdomen. The two patients with burning pain, one with a femoral and the other with a sciatic nerve lesion, were classified as good and poor respectively.

The painfree patients had to use stimulation for two hours up to four times a day. The partially successful cases had to stimulate for one hour every second hour.

DISCUSSION

From published reports (Picaza *et al.* 1975; Campbell and Long 1976; Law, Swett and Kirsch 1980; Nashold *et al.* 1982) it is clear that the best results are to be expected from the use of peripheral nerve stimulation in peripheral painful neuropathies. In our series, 79% of the patients obtained considerable relief of pain and 57% were completely painfree for a period of up to 29 months.

The burning pain suffered by two patients in our group did not improve (one was classified as good because there was reduction, although not disappearance, of pain), so perhaps this type of pain is not suitable for treatment by stimulation.

It also seems likely that neuropathies of the tibial and peroneal nerves are best controlled by sciatic nerve implantation: thus, although one of our patients with a neuropathy of the peroneal nerve was rendered painfree, in two peroneal nerve and two tibial nerve neuropathies where implantation was close to the lesion, we had poor results or only partial success.

Although we assume that ectopic firing is the basis of peripheral painful neuropathies (Howe 1979; Calvin 1982), the mechanism by which peripheral nerve stimulation relieves pain is largely unknown.

Conclusions. From the scanty reports available and from our own short-term results it seems that, provided cases are carefully selected, pain derived from peripheral neuropathies can be controlled by proximally implanted peripheral nerve stimulators.

Selection has to include accurate diagnosis of a peripheral nerve neuropathy; exclusion of cases with burning pain; complete pain relief by selective nerve block with minimal local anaesthesia; and pain relief by percutaneous nerve stimulation with high frequency and low voltage current. Finally, it is important to place the electrode cuff as proximally as possible; for the nerves of the leg it should be on the sciatic nerve.

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